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MOONLIGHT TABLES.

This year, as for many years past, Mr. H. W. Frund, the well-known central station manager, has prepared for us moonlight tables for street lighting work, to be used in 1907. With the present issue we furnish these tables in the wonted form of a broad sheet supplement. We are glad to know that these tables are very much appreciated by our numerous central station readers. Extra copies may be obtained on application to the business department of this journal.

It would interest some of our readers greatly if they knew how wide the range of possible and actual variation is in lighting schedules. The National Electric Light Association lists in its lighting statistics seven standard schedules with 152 variations. There are certainly more than that extreme number of changes on which city contracts are based, a fact often forgotten by people who quote rates from one city to apply in arguments elsewhere.

COMMERCIAL INCANDESCENT LAMPS.

The paper by Prof. Spinney on lamp tests, printed elsewhere, is suggestive of several instructive lines of thought, aside from the carbon filament lamp, which promises soon to be a thing of the past. The old carbon lamp of the 3.1 or 3.5-watt variety has three undeniably good points: ease of uniform manufacture, low first cost and reasonably good life. The tests of Prof. Spinney are directed mainly toward the question of uniformity, and they are particularly instructive as showing how slipshod methods of manufacture and sorting may injure the average quality of a product. The lamps examined are certainly not a creditable exhibit from the standpoint of uniformity, the less so since it is very well known that with proper care in sorting there is no excuse for large variations. To find in a batch of less than 400 3.5-watt 16-cp lamps examples of 12-cp and 20-cp lamps, and power consumption ranging from 50 to 65 watts, is exceedingly discreditable to some of the makers. We strongly suspect that most of the discrepancies could be traced to lamps of a few evidently careless manufacturers. Incandescent lamps are demanded in such huge quantities that there is great temptation to grow lax in testing and sorting.

American manufacturers in many lines have yielded to the pressure in the recent years of large demands and hurried deliveries and with results that are beginning to be felt. Inspection grows lax and when that specious and degrading process, inspection by sample, begins to creep in, there is trouble ahead. To such laxness one must definitely charge the fact brought out by Prof. Spinney, that about one quarter of the lamps tested were improperly exhausted. This particular fault is absolutely inexcusable. Is it possible that under the pressure of "prosperity," signalized by haste and winking at imperfections that would not be tolerated for a moment in times of keen struggle for business, we are to have, or already have, an irruption of the "cheap and nasty" incandescent lamps disclosed in some recent English investigations? Uniformity and uniform excellence of product is certainly attainable in lamp manufacture. Low first cost is cer-

tainly a strong point of the old lamp and none of the new ones seem to have reached, or to be likely to reach, at all a similar plane of price. And first cost is in some cases an important matter, particularly when coupled with good life, equivalent to a still further decrease in cost. In many cases efficiency does not practically count for much. In display lighting, for example, a 4-cp lamp taking about 20 watts is widely used. It is important, therefore, that its manufacture should not be allowed to degenerate into shiftlessness on any theory of a revolution in the art. Revolutions in such things take time.

Central station companies are, however, about as much to blame for this condition of affairs as lamp manufacturers, for two reasons. In the first place, the majority of central station companies have in the past made no effort to test the product received from the lamp makers, and in the second place they have insisted on adhering to certain common voltages, whereas in many cases if they had raised or lowered their lamp voltage two or three per cent so as to require lamps of a slightly different voltage from those which are commonly used, they could more easily and certainly obtain a good selection of lamps. It is not by any means necessarily true that the numerous lamps which fall outside the target in the diagrams presented by Prof. Spinney are poor lamps. These lamps if burned at the proper voltage might show an excellent performance under a life and efficiency test. The point is that they have not been placed in their proper class. While there is more interest at the present time in the new high-efficiency lamps than in the common old-fashioned carbon filament lamp, it is but reasonable to suppose that the same general principles which apply to the selection and purchase of the common incandescent lamp of to-day will hold true in regard to the new lamps. The sooner central station companies can get into the general practice of purchasing lamps on a scientific basis as to life, candle-power and efficiency, backed up by tests on samples of all lots purchased, the more carefully will the manufacturers select and classify their lamps. It is unreasonable to suppose that they will take the trouble to do this as long as the purchaser concerns himself so little as to what he is getting. The incandescent lamp industry has settled down to such a point now that nearly all factories turn out good lamps and all turn out some poor ones. Such is inevitable in the process of manufacture, so that it settles down mainly to a question of selection.

Phenomena of Commutation.

Some experimental results by Prof. F. G. Baily and Mr. W. S. H. Cleghorne on contact resistances between carbon and copper have recently appeared in the London *Electrician*. The experiments show definitely what has been already known, perhaps less definitely, that the drop of pressure across a carbon copper rotating surface contact increases very slowly with the current density over the contact area, being roughly proportional to the fourth root of that density. The current through the brush has to be increased about twelve-fold before the voltage drop in the contact resistance is doubled. The drop also diminishes slowly with the mechanical pressure of contact. Increasing the pressure on the carbon brush does not bring down the contact resistance in anything like the ratio of increase, and at the same time increases the power expended mechanically in friction. By a patriotic adhesion to the old British system of weights and measures worthy of a better cause, some terrible units are derived in the paper, as for example a coefficient of friction in "watts-per-ounce-per-foot-per-minute-per-square-inch." This particular unit of friction coefficient is alleged to have been selected for convenience. We offer no criticism upon the definition of what constitutes convenience, but only upon the maintenance of a system which makes such incongruous units convenient. The simplicity and ease of reading in Hobart's metric system books contrasts sharply with such metrology.

An interesting and important experimental observation is brought out, namely, that paraffin wax applied as a lubricant to the copper drum, reduced the mechanical friction or the aforesaid watts per ounce per foot per minute per square inch to one-fifth, and yet did not increase the contact resistance under running conditions, although paraffin wax is itself a highly insulating substance. Moreover, when the drum lubricated with paraffin wax was brought to rest, the contact resistance increased very greatly. The effect of a rubbing contact, or the continuous relative motion of the contacting parts, in effecting electric contact over the lubricated surface is very remarkable, and is, we believe, not generally known.

Oscillographic records illustrate the paper and indicate the magnitudes of the e.m.f. between brush and commutator bars at the moments of separation. They show also how complex the phenomena of commutation frequently become, the contour of the e.m.f. waves being in some cases very irregular. The influence of commutating poles, or interpoles, in reducing the sparking e.m.f. is clearly brought out. As pointed out in the paper, multipolar machines, with parallel-connected armatures, are less likely to spark seriously than bipolar machines of the same power, because the various sets of brushes break circuit in commutation at slightly differing times. The phenomenon of sparking at the commutator is perhaps one of the most difficult encountered in dynamo-electric machinery, and experimental researches of this kind are thus very valuable.

Electric Drive for Power Plant Auxiliaries.

It now seems to be becoming generally accepted that although the electric driving of feed-water pumps, condenser pumps and other small auxiliary apparatus around a station can be accomplished with considerably less steam than would be required to drive these auxiliaries by steam direct, it is nevertheless easy in a condensing plant to carry electric drive of auxiliaries too far so that there will not be sufficient exhaust steam to heat the feed water. With insufficient exhaust steam to heat the feed water live steam has to be used for that purpose unless the boilers are fed cold water, which is a very undesirable practice. Looking at the situation in this way, the lack of economy of the average feed-water or condenser pump becomes of secondary importance because such pumps simply act as a kind of reducing valve through which the feed-water heater is supplied. After the point is reached when there is enough exhaust steam to heat the feed water, it is time to consider the use of electric drive on the remaining auxiliaries. Of course, in the case of a non-condensing plant where there is plenty of exhaust from the main engines, electric drive is another proposition. We have seen a good many motors in use around power stations for various purposes, such as driving stokers, conveyors, pumps and the like, where insufficient attention had been given to the importance of being able to vary their speed, the designer apparently having forgotten that variable speed is one of the necessities in many power plant auxiliaries.

THE SCREENING OF LAMPS IN AUDIENCE ROOMS.

The question of placing lamps in audience rooms and churches where their light cannot shine directly into the eyes of those in the congregation, is one which is rightly receiving an increasing amount of attention from all interested in good artificial illumination of such places. The effect of strong artificial light shining into the eyes of persons in an audience as they sit steadfastly looking toward a stage or platform is unquestionably bad. The principal methods suggested for reducing this evil until very recently were either to place the lamps very high so as to be out of the ordinary range of vision, or to use large diffusing enclosing globes so as to reduce the intrinsic brilliancy of the sources of light and make the light come from the surface of a large globe rather than from a small filament. While these methods reduce the evil, they do not by any means entirely do away with it. Messrs. Cravath and Lansingh, in an article on church lighting in the ELECTRICAL WORLD of October 6, pointed out a fact, evident to any careful observer, namely, that the mere placing of lamps high does not do away with the discomfort due to the light shining in the eye. Relief is not secured until such an angle with reference to the eye is reached that the eyebrows actually shade the eye. In fact, light shining into the eye from high up may be more uncomfortable than a well diffused light almost in the line of vision.

The natural conclusion to be drawn from this is that in the proper and comfortable illumination of a church or audience room, most of the lamps must be screened in some way so that no injurious rays can be thrown backward at an angle of more than 25 degrees from the vertical, which is about the angle at which the eyebrow shades the eye. How to accomplish this is a matter worth study by illuminating engineers. One solution which is feasible in some places is to hide the lamps behind architectural details of the ceiling, such as beams or domes. While this is feasible in some cases, in others it is not. Another plan is that of concealing the lamps in a cove or cornice and depending upon the reflection from the ceiling, this plan being ordinarily known as indirect lighting. The expense of this method makes it prohibitive in most cases. A large amount of power is required to deliver enough light where it is wanted even when the arrangement is new and the walls are clean. The coves in which the lamps are placed are excellent dust receptacles, and the arrangement loses efficiency rapidly. A third method is that suggested by Messrs. Cravath and Lansingh in the article before referred to, namely, that of designing special fixtures which will screen the lamps, harmonize with the surroundings, and at the same time be reasonably efficient. The latter method has been tried to only a limited extent as yet, but seems to be one which will justify considerably more thought than has yet been given to it by both fixture dealers and illuminating engineers.

HIGH-FREQUENCY SUSTAINED OSCILLATIONS.

The importance of developing a practical method for maintaining in a circuit constantly sustained oscillations has recently become prominent in connection with wireless telegraphy. The ordinary method of producing signals at the transmitting station consists, as is well known, in charging a condenser, and in permitting it to discharge by oscillations at a desired frequency, the amplitude of the oscillation rapidly dwindling. In acoustic analogy, the string is plucked, as in the banjo. On the other hand, when the sending antenna is excited into continuous oscillation, the acoustic analogy is presented of bowing the string; so that, from an acoustic standpoint, the substitution of undamped, or sustained, oscillations in the antenna, for the highly damped discontinuous oscillations of intermittent discharges, is equivalent to the substitution of the fiddle for the banjo, with a correspondingly marked increase in radiating power and efficiency. It is, of course, possible, at least theoretically, to apply a high-frequency alternator to the sending antenna; but the frequency has to be hundreds of thousands, or at least tens of thousands of cycles per second, which usually damps the ardor of the prospective constructor. The speed of rotation called for in an alternator capable of producing the desired frequency is enormous. Attention has recently been directed to the phenomenon, first published by Prof. Elihu Thomson, that when an arc lamp in a direct-current circuit is shunted by a condenser, oscillations can be made to show themselves in the condenser. It was afterwards ascertained by Duddell that certain conditions are necessary in order that the phenomenon may be presented. Poulsen has recently experimented with the arc in hydrogen, which he finds to be a suitable gas for the production of oscillations in the shunt circuit. We have recently referred to these experiments, both editorially and in the Digest.

The *Elektrotechnische Zeitschrift* has recently published an article, by W. Hahnemann, on the same subject. It appears that the continuously maintained arc discharge is not well adapted to the production of oscillations. What is desired is a pulsating arc, supplied by a direct-current circuit, the frequency of pulsation being determined by, and equal to, that of the free oscillation frequency in the shunt circuit. The best substances yet found for the electrodes are copper for the anode or positive and carbon for the cathode or negative. The copper anode has to be kept cool, since otherwise a continuous stream of metallic vapor, or arc discharge, occurs between the electrodes. Herr Hahnemann describes a copper electrode of diameter about five times as great as that of the lower carbon electrode, and formed into a hollow copper bottle, containing water for cooling the electrode surface. The bottom of the bottle is hollowed inwards like the crater in a large positive carbon, so that the arc is enveloped by a cool metallic surface. A number of such arcs are associated in parallel under one and the same hollow copper anode. By this means the amount of energy which can be set in oscillation is increased. The anode may then be connected directly to the sending antenna, and the cathode to ground. When the proper adjustment is made the antenna can thus be brought into vigorous oscillation, the power dissipated in radiation being taken from the direct-current source.

Our London contemporary, *The Electrician*, has also recently published an article by S. G. Brown upon a similar method of developing energy of oscillation from a direct-current circuit. A rotating metallic disc has a balanced copper block resting upon its periphery, so as to produce a loose metallic contact. A strong direct current is passed through the contact and the contact is shunted by a condenser circuit. A very short arc discharge is set up at the rubbing contact, the rotation of the disc serving to keep down the temperature of the arc. The arc thus set up tends to be thrown into rhythm by oscillations in the condenser shunt, and thus serves to bow that shunt into oscillation. There are probably other ways open to the development of oscillating electric energy from a direct-current source; there can be no doubt that such sustained oscillations are greatly to be desired for long-distance wireless telegraphy.

Supervising Industrial Corporations.

The recent annual reports of Government departments and bureaus deal largely with the economic and sociological questions involved in the proposed supervision of industrial corporations. Secretary Metcalf, of the Department of Commerce and Labor, says in regard to the work of the Bureau of Corporations: "The results thus far obtained fully justify the creation of the bureau. Its investigations have furnished reliable information regarding the conduct and business of corporations engaged in interstate and foreign commerce. The facts presented as to the relation of such corporations to the state and the inability of the States to effectually curb the improper exercise of corporate powers, lead inevitably to the conclusion that the Federal Government must directly regulate and control such corporations.

"Of the methods suggested for exercising this power the Federal franchise plan seems the most feasible. This plan is simply to require the greater industrial corporations to obtain a license from the Federal Government if they are to engage in interstate and foreign commerce. There would be no interference with the powers of a State over the creation of corporations nor their actions wholly within the State. Under a license the Federal Government should require, as a condition precedent to granting the license, a full disclosure of all facts necessary to show the ownership, properties, financial condition and management of the corporation; furthermore, the corporation's records should be open to proper inspection; annual reports should be required; and, finally, the Government should have the power to revoke the license and prevent the continuation of engaging in interstate and foreign commerce in the event the corporation fails in its obligations toward the Government or is convicted of violating Federal laws. Ordinarily the imposition of fines does but little to correct corporate abuses, but if the penalty be the denial of the right to continue business a most effective remedy is provided."

Dealing with the same subject, Mr. J. R. Garfield, Commissioner of the Bureau of Corporations, urges the necessity for the establishment of Federal inspection and supervision of the greater industrial corporations engaged in interstate and foreign commerce. He says it will not interfere with the power and authority of the States over the corporations created under State laws, and is not an invasion of private rights, but merely will "restore individual responsibility and prevent the corporations from being the hiding place of the irresponsible, dishonest or corrupt manager."

Denial of the right to engage in interstate commerce is suggested as the penalty for proved violation of the law. The report says the work of the year strikingly demonstrates the value of efficient publicity for the correction of corporate abuses.

Wireless Telegraphy in the United States.

Among other important subjects, Rear Admiral William S. Cowles, chief of the Bureau of Equipment, in his annual report to the Secretary of the Navy lays special emphasis on the work done by the navy in wireless telegraphy. "It appears," says the report, "that the commercial possibilities of wireless telegraphy are not as great as originally anticipated, since the revenue derived therefrom is small and apparently not commensurate with the cost of installation and maintenance of coastwise long distance stations. But the value of wireless telegraphy for the purpose of national defence is inestimable. It is, therefore, essential that absolutely reliable communication at the longest possible distances be maintained between naval ships at sea, between ships and shore stations, and between the shore stations themselves along our coasts and outlying possessions."

The United States has 209 wireless stations, against 238 in all other parts of the world and controlled by other nations. Steps have been taken toward making the stations at the Washington and New York navy yards directly intercommunicative, day and night, for use as testing and experimental stations.

Figures of Investment in Telephony.

Last week we printed an abstract of the report of Mr. H. P. Nichols, assistant engineer of the New York Board of Estimate and Apportionment on telephonic franchise conditions and investment in America. Mr. B. G. Hubbell, president of the Consolidated Telephone Company of Buffalo, which has formed a merger with the Great Eastern Telephone Company, has written a letter to Mr. Nichols, in which he says: "My attention has been called to your report of November 21, 1906, to Hon. George B. McClellan, chairman Board of Estimate and Apportionment, and on page 20 of this report I notice reference to a comparative capitalization between the Frontier Telephone Company, of Buffalo, and the Bell Telephone Company of Buffalo. This report is so misleading in its deductions and so manifestly unfair to the independent telephone companies that I am constrained to write you on the subject, so that you may correct your comparative statement of these two companies.

"In the first place, you have used the authorized instead of the paid-in capital of the Frontier Telephone Company as a basis for its costs per telephone, and, in the second place, you have underestimated the capitalization issued by the Bell Telephone Company, its capitalization being $7,260,000, instead of $6,700,000. I am not informed as to the number of telephones the Bell company has in this district, but am willing to take your figures as a basis of comparison, namely, 53,977 telephones, total, with 22,044 telephones in Buffalo. This would leave 31,933 Bell telephones outside of the city of Buffalo, which, of course, would cost much less than the telephones installed in Buffalo.

"It is a well-known fact that in small communities, such as covered by the Bell Telephone Company in its rural districts outside of Buffalo, telephone systems can be constructed at $50, and not to exceed $75, per telephone, and the 31,933 telephones, at, say, $75 per telephone, would account for $2,400,000 of its capitalization of $7,260,000, leaving $4,860,000 as the cost of its Buffalo property. You then have 22,044 telephones in Buffalo, with an investment of $4,860,000, showing a cost of $221 per telephone in Buffalo for the Bell system."

The Electric Induction Furnace.

Mr. John Harden, formerly with the General Electric Company, and now connected with the company applying the Kjellin electrical process for the manufacture of steel, delivered a lecture on December 3 before the Sheffield, England, Society of Engineers and Metallurgists on the subject of steel making in electric induction furnaces. Mr. Harden states that as early as 1886 Ferranti realized that metal could be successfully melted by means of the induction principle, and he constructed a small furnace for this purpose, at the same time securing a patent. Owing, however, to the fact that at this time suitable current was not available, he was compelled to defer further experiments. Mr. A. E. Colby, of the United States, about the time secured a patent on an induction furnace which was designed and intended for melting platinum, and has recently constructed a small furnace for steel melting. In 1899 Mr. Kjellin, of Stockholm, Sweden, took up the matter, and recent patents have been taken out on induction furnaces by Frick and Wallin, of Stockholm; Gin, of Paris, and others.

The induction furnace is described as nothing else than a common transformer in which the charge of metal forms a secondary winding of one single turn, and its principal advantage is that it allows a charge to be heated up to any desired temperature without contact with injurious products of combustion. A further advantage is that the heat is transmitted direct to the charge without the interposition of any radiating surface, the result being a melting machine of high efficiency. It is claimed that owing to its principle the Kjellin furnace operates with a much higher power factor than other induction furnaces and enables normal frequencies (25 to 50 cycles per second) to be used. The commercial advantage of the induction furnace is stated to be in permitting of larger casts, a cheaper and cleaner form of melting and reduced cost of labor.

The efficiency of the furnace in operation at Gysinge is stated

to be 50 per cent, or under favorable conditions up to 55 or 58 per cent. Thus one ton of steel will require from 800 to 850 kw-hours of electrical energy. Two men and one boy will run a furnace turning out four tons in 24 hours. The cost of lining, including repairs, should not exceed 67 cents per ton, and the actual cost for melting one ton of steel should thus be well under $15 per ton, or very much less than by ordinary furnace methods.

At Gysinge, Sweden, a furnace of 170 kw has been operating successfully for the past five years and two others are being constructed at Guldsmedshyttan, also in Sweden. In Germany two furnaces are being operated and three are being constructed, two of which are of 750 kw. In Switzerland a furnace of 450 kw is now being worked, while another of 200 kw will shortly be started in Spain. In England a furnace of 200 kw is now at work and others are in course of construction.

Electric Power Development in France.

Reports received by the United States Department of Commerce & Labor from Consul Chapman Coleman, of Roubaix, show the tendency in France toward the utilization of electricity for industrial purposes. Mr. Coleman writes, in part: "In connection with an industrial exposition recently held in the neighboring city of Tourcoing several French authorities in electrical science have delivered instructive lectures on the more extended use of electrical energy in industrial establishments in France. While its industrial use in this region is yet limited, its contemplated larger employment in a section of France teeming with factories whose enormous varied productions, of which a considerable amount is exported to the United States, cannot but be regarded with great interest. This Department of the North, with an area of 2,205 square miles and a population of about 2,000,000, exported to the world in the calendar year 1905 products of the value of about $88,000,000 and to the United States of about $2,500,000. The success, notwithstanding the relatively high prices demanded, recently achieved by the *Société Lillois d'Eclairage Electrique*, through the increased capacity of their plant, which has greatly stimulated competition in this domain, has led to the establishment in the city of Lille or its environs of four further plants of large capacity for the production of electrical energy. The latest is a plant of 25,000 hp about to be constructed at Marquette. It is also reported that a fifth enterprise will obtain the supply of electrical energy needed for its customers from certain mining companies of the Department of the Pas-de-Calais.

"While it will not be practicable to make general competitive price comparisons, an idea of relative cost may be formed from a comparison of proposed prices for electrical energy in the annexed table with the cost prices given in the following examples of motive power generated by the ordinary means of steam and gas: (1) For an industry whose continually varying needs are from 25 to 100 hp, the industry considered being a printing establishment, the cost price per kw-hour is per machine 0.19 franc; (2) for an industry constantly requiring 100 hp, the industry considered being a spinning mill, the cost price per kw-hour per spinning frame is 0.146 franc (franc = 19.3 cents). The new electric companies have established price schedules, the figures being essentially the same for all. These are based upon a progressive decrease in cost, beginning with a charge of 0.20 franc per kw-hour for a smaller horse-power and lowered to a charge of 0.05 franc and less per kw-hour for subscribers, for 5 hp or more, utilized during a stated number of hours.

"The prices given in the following table are stated by the companies on the basis of the reckoning that the hours of utilization are equal to the kw-hours consumed, divided by the kw-hours installed:

	Price in francs per kilowatt hour.			
Power installed in kilowatts.	For the first 1,000 hours of utilization.	For the 1,500 hours following.	For the 2,000 hours following.	For more than 4,500 hours.
Less than 3 kilowatts	0.20	0.20	0.20	0.20
From 3 to 6 kilowatts	.20	.14	.09	.05
From 6 to 10 kilowatts	.19	.13	.085	.05
From 10 to 15 kilowatts	.18	.12	.08	.05
From 15 to 24 kilowatts	.17	.115	.075	.05
From 24 to 36 kilowatts	.16	.11	.07	.05
From 36 to 50 kilowatts	.15	.10	.07	.05
From 50 to 80 kilowatts	.14	.095	.065	.05
Above 80 kilowatts	.13	.09	.06	.05

"It should be added that for quantities of 500 hp or more these companies have already entered into contracts at prices lower than 0.05 franc per kilowatt hour."

Technical Education in Ohio.

In his presidential address before the Ohio Society of Mechanical Electrical and Steam Engineers, delivered at Akron, Ohio, November 16, Mr. Wm. T. Magruder, gave much interesting information concerning the present status of technical education in Ohio. Before the end of the territorial government, there was among the territorial laws an act providing for the charter of "The American Western University." Among the first acts of the new state was the renewal of this charter, and the beginning at Athens in 1804 of a school under the new name of the Ohio University. Miami University at Oxford followed in 1809. Western Reserve University at Cleveland was chartered in 1826; Oberlin College in 1833; Mount Union College at Alliance in 1846; University of Wooster in 1870; Kenyon College at Gambier in 1824; Denison University at Granville in 1831; Marietta College in 1835; Muskingum College at New Concord in 1837, and Case School of Applied Science at Cleveland in 1881. The Ohio State University at Columbus was founded by act of Congress in 1862, but was not opened for students until the fall of 1872.

The University of Cincinnati, which is controlled and supported by the municipality, was started by a bequest received from Mr. Charles McMicken after his death in 1858. In 1901, the trustees of the Cincinnati Technical School, which was founded in 1886, transferred the schools building to the directors of the University. The Technical School is a manual training high school, and is under the management of the Board of Directors of the University, but it has no organic relation otherwise with the institution.

Within the last year or two, a system of co-operative engineering education has been devised by the University of Cincinnati, in connection with about thirty-five of the largest mechanical and electrical manufacturing companies of Cincinnati and vicinity. The project contemplates a working arrangement whereby practical technical knowledge will be obtained in the factories, and the theory of engineering at the University, thus having the education of the head and hand progress together.

Manual training is being taught at the Ohio Mechanics' Institute in Cincinnati, at the Technical School of Cincinnati, and at the Jewish Orphan Asylum in Cleveland. It is also being taught in the high schools of Canton, Cleveland, Dayton, Elyria, Norwood and Toledo, and possibly others which have been started this year.

Chicago Meeting of the Illuminating Engineering Society.

The Chicago Section of the Illuminating Engineering Society held a meeting December 6, at Burton White's restaurant to discuss the papers by Messrs. Millar, Zalinski and Olcott, read at the New York meeting November 9.

Mr. C. W. Pendell, being called upon to give his ideas on arrangement of lamps in factories, outlined the arrangement used in the Western Electric Company's shops in Chicago where he formerly had charge of the lighting. The plan there adopted as the result of experience was to locate outlets uniformly 8 ft. apart, varying the candle-power of lamps at each outlet to suit the conditions. The ceilings were 9 ft. high. Lamp clusters were placed about 8 ft. above the floor.

Mr. J. R. Cravath, in discussing the question of fixture design, condemned the general use of fixtures with electric lamp sockets pointing at an angle of 45 degrees. This angle, he said, was very well if bare lamps were used, but if any class of reflectors or globes for directing the light downward were employed, a much better selection was available if the sockets were pointed straight down because there were only a few types of glassware which could be used to direct the light downward without introducing objectionable glare in the eyes when the sockets are

at an angle. It is also more difficult to get uniform distribution from a chandelier with sockets at an angle than with them pendant. Globes and shades are likely to sag and look badly when placed at an angle, which is another good reason for making them pendant.

Mr. L. G. Shepard inquired as to the effect of dirt on globes and reflectors and Mr. Cravath cited tests by Leggett & Townsend in various Chicago buildings several years ago, from which it appeared that loss of light due to dirt might in some cases be as high as 75 per cent. The dirt resting on top of a reflector, of course, absorbed but little light because but a small amount of light passes through a reflector compared to that which is reflected. Dirt on the lamps and on enclosing globes will, of course, absorb a great deal of light.

Mr. O. J. Bushnell thought that the change from fixtures with lamps at an angle to fixtures with lamps pointed either straight up or straight down was one of the most important improvements in design recently made. With such designs the lamp filaments could be properly covered with diffusing glassware as they could not otherwise. A very practical suggestion was made by him as to improvement in a very common form of dining room fixture. Many dining room fixtures have a dome on the bottom for lighting the table and lamps on the chandelier arms around this dome, these lamps being placed at an angle. By pointing these upward and using diffusing shades or globes, these lamps could be properly protected from the eyes and give a good general illumination of the upper part of the room, that being the purpose for which the lamps outside the dome are used.

Mr. George H. Lukes called attention to the fact that central station men had so far been taking more interest in the Illuminating Engineering Society than any other class. He would like to see more architects and fixture men in the Society, as usually they were the ones upon whom depended the arrangement of the illumination. The central station man frequently did not get a chance at the design.

Mr. John G. Learned thought the central station man could sometimes secure efficient design by taking up the question of illumination direct with the owner as soon as the building permit is issued. He then described the lighting arrangements in his residence which contained many good points. In the parlor was a three-light chandelier with sockets about 15 deg. from vertical in Holophane enclosing globes which concentrated the light downward. There was also an ornamental bracket with a square art glass shade supported by a chain. Inside of this was a 100-watt "Gem Meridian" lamp with reflector. This was an arrangement especially admired by visitors. In the bay window was an art glass shade with a 16-cp lamp. In the hall was a one-light pendant with the lamp in a Holophane globe. In the dining room there was a chandelier with three arms provided with Holophane stalactite globes and from the middle of the chandelier was hung, by means of a chain, an art glass dome. This was hung low over the table and had inside of it a 50-watt "Gem Meridian" lamp with reflector. In the kitchen near the ceiling in the middle was a 50-watt "Gem Meridian" lamp in an "X-Ray" conical reflector which proved a very satisfactory arrangement. Mr. Cravath called special attention to the good point made by Mr. Learned of having lamps used under art glass domes equipped with reflectors which will give the desired distribution of light, over dining room tables or for reading purposes.

Mr. E. D. Alexander said that the use of combination fixtures frequently defeated the most pleasing and effective electric lighting. Where combination fixtures are used the necessity of having them within reach for lighting makes it frequently impossible to place them as would be desirable were they purely electric fixtures. There was a time when the uncertainty of central station service made it necessary to have both gas and electricity on a chandelier, but that time is passed.

Mr. J. C. Strasser reviewed some of the difficulties of the central-station man in getting the architects to accept lighting arrangements which would suit the customer after the job was finished and not make trouble for the central-station company. He cited one or two cases where as a central-station manager, he had gone direct to the owner when he found that the architect was intending to put in some ridiculously inefficient arrangement. While the architects did not like to have their designs interfered with, the customers were usually pleased.

It was decided to hold the next meeting January 17 at the Coliseum Convention Hall during the Electrical Show; and since the Northwestern Electrical Association will be holding its convention in Chicago at that time, it was voted to invite the Northwestern Electrical Association to come as a body and take part in the meeting.

Meeting of the Mechanical Engineers.

Note was made last week of the annual meeting then in progress of the American Society of Mechanical Engineers in New York City, presided over by Mr. F. W. Taylor, who is now succeeded in the presidency by Prof. F. R. Hutton, so long secretary of the institution. The other new officers chosen at the meeting were J. W. Lieb, Jr., P. W. Gates and Alex. Dow, vice-presidents; A. J. Caldwell, G. M. Basford and A. L. Riker, managers, and W. H. Wiley, Treasurer.

All the regular meetings were held at the Edison Auditorium of the New York Edison Company, in West Twenty-seventh Street; but there were several trips and entertainments. On Wednesday afternoon the members visited and admired the new Engineering Building, and also examined the Cahill telharmonium plant and listened to its rich and beautiful music. This electro-mechanical creation of music from alternating currents evoked great admiration. Several of the visitors went back more than once.

On Thursday afternoon the members of the society were taken as guests of the New York Central Railroad Company by a special ten-car train to the Port Morris power station, which is one of the two stations from which electrical energy is to be supplied to the motor cars and locomotives throughout the electric zone of the New York Central and throughout the direct-current zone of the New Haven Railroad. This station, a description of which was given in Electrical World for September 29, is now complete in every detail and is ready for operation at its full capacity of 20,000 kw. The members found much pleasure in inspecting the boiler plant, the 5,000-kw turbo-alternator units and auxiliary equipment and the switch house in which are placed all of the controlling devices for the electric motors and generators.

One of the most striking features of the whole equipment resides in the numerous precautions taken to insure continuity of service. Each high-tension switch is placed in a separate fireproof compartment, the remote control switchboard is in duplicate and can be operated from either the gallery overlooking the generators or from the switch house, which is entirely separate from the generator room. There are three sources of supply of exciting current for the alternators; a steam turbine-driven unit, an induction motor-driven unit and a storage battery. The turbine exciter unit proved to be the object of much study on the part of the members on account of the novel construction used with the generator. The generator armature core is provided with two separate armature windings each connected to its own commutator; these two commutators are connected in parallel external to the machine. On account of the excessive force to which a commutator of normal length would be subjected at the high rotative speed, each commutator is built up in two parts electrically interconnected to form a single commutator. The field core of the generator is provided with inter-spaced auxiliary poles to prevent sparking at the commutator.

A system of colored lamps serves to indicate to the switch attendant the position of each switch in the generating equipment, while a miniature metallic circuit diagram interconnected with colored lamps is employed to show the position of trains throughout the electric zone. The metallic diagram is placed in an isolated room in the switch house, in which is located also a complete telephone switchboard. The switchboard is connected not only to various points in the switch house and the power house, but also to points along the track in the electric zone, so that the telephone switchboard room will serve as the office of the train dispatcher.

On Friday afternoon between 600 and 700 members of the society were conveyed by special train over the New Jersey Central Railroad to Sandy Hook, where they were taken in charge by a detail of artillery officers and shown some of Uncle Sam's big guns and how he tests them. The day was bitterly cold and a fierce gale blew across the dreary waste of sand, but these discouragements had no terrors for the visiting engineers. An incident of the trip was the segregation from the party, by an army officer, of seven aliens, who were aboard the train, and kept in "durance vile" while the crowd of "American citizens" were enjoying themselves seeing things in the howling gale. This action, which came as a great surprise, is explained by the fact that no one but American citizens are allowed within the fortifications of the United States Government. The "prisoners" were well taken care of, however, and shown every courtesy permissible under the circumstances.

After alighting from the train a 16-in. gun was inspected. This great piece of ordnance was described by Gen. Crozier, who gave some interesting facts and figures concerning it. It is 49 ft. long, nearly 6 ft. in diameter at the breech and weighs 130 tons, its cost being in the neighborhood of $150,000. The "ordnance front"—a concrete platform on which guns large and small are tested—was next visited. Here 6-in. rifles and other smaller pieces were shown in action and as each shot was fired hundreds of eyes were turned seaward to watch for the splashing as the missiles fell into the water. But the most interesting of all the firings was that of a 10-in. gun of the disappearing type. When the piece was ready to be fired it was lifted in the air above the carriage and on its discharge—which was with a mighty roar—it settled back into its carriage with a motion so easy and graceful that it excited the admiration of every one present and evoked hearty applause.

The next event of interest was the manœuvering of a 12-in. disappearing gun operated by electric power. The power is supplied by a General Electric motor-generator set located in the casemate near the gun, which set receives its energy from the main generating station on the grounds. This great gun was manœuvered with facility and its disappearance within its emplacement after firing was interestingly demonstrated. The ammunition for all of the large guns is delivered by electrically-operated hoists, which were in operation. The party then proceeded to the mortar battery, where four 12-in. mortars were fired simultaneously with a roar that shook Sandy Hook to its foundations. After a lapse of several seconds the shot splashed into the ocean over a mile away.

After exhibitions of firing explosive shells with black powder and high explosives, a visit was made to the mine pit from which submarine mines are controlled and exploded by electricity. General Murray, chief of artillery, explained that the mines may be exploded in three ways: one by direct contact, and the other two from shore by electricity. The building contains considerable apparatus for the control and operation of the mines. The range-finding apparatus in the range station was next shown, as were also the ballistic instruments which are located in the building occupied by the headquarters of the post.

It was noticed that Uncle Sam is partial to concrete construction. All of the new works are constructed of this material, and the excellence of finish and substantial appearance called forth much favorable comment. Before departing for home the visitors had an opportunity of meeting the army officers, who had done so much to make the day interesting for them.

A. I. E. E at University of Illinois.

The University of Illinois Branch of the American Institute of Electrical Engineers held its regular monthly meeting at the Electrical Laboratory of the University at Urbana, Wednesday evening, December 5, with an attendance of 56 members, associates, students and guests. Mr. P. Junkersfeld and F. H. Smith, of the Chicago Edison Company; Mr. Wiemer, of the Wagner Electric Company, of St. Louis, and Messrs. F. D. Smith and Bunn, of the Illinois Traction System, were visitors. The lighting papers of the November New York meeting were presented: that of Dr. Steinmetz, on the "Transformation of Electric Power into Light," by Prof. Carman; that of Mr. Sharp, on "New Forms of Incandescent Lamps," by Prof. H. P. Wood. Through the courtesy of Mr. Junkersfeld, samples of metallized filament, of tantalum, and of tungsten lamps were exhibited and compared. This was the first exhibition of the tungsten lamp at the University. Discussion was animated, and the influence of the new lamps upon the problems of electric lighting and production were considered.

Refreshments were then served when the meeting adjourned to the laboratory proper, where was given a demonstration of the method of self-synchronizing of alternators invented by Messrs. Brooks and Akers, as described in their Milwaukee convention paper. Apparently reckless closing of alternator switches was shown to be perfectly safe and proper synchronizing to be invariably free from noticeable disturbance of the lamp load. The Institute branch sessions this season have had a large attendance, the number present on this occasion being restricted by the very bad weather that prevailed. The meeting was quite informal, and was greatly enjoyed by all. Owing to the Christmas holidays the January meeting will occur the second Wednesday in January.

CURRENT NEWS AND NOTES.

AUTOMOBILE DESIGN.—At the next meeting of the Electrical Engineering Society of Columbia University, Mr. E. Favary will present a paper on "Automobiles, History and Development," at 8.15 p.m., Wednesday, December 19, in Room 301, Engineering Building. All interested are cordially invited to attend.

NEW YORK ELECTRICAL SOCIETY.—The 264th meeting of the society will be held at the Edison Auditorium, 44 West Twenty-seventh Street, Wednesday, December 19, at 8 p.m. Mr. A. O. Benecke, of the American Instrument Company, Newark, will deliver an address on "Electrical Measuring Instruments." The lecture will be illustrated with lantern slides.

CARNEGIE SCIENCE GRANTS.—The Board of Trustees of the Carnegie Institution of Washington has appropriated $661,300 to aid in scientific researches of various kinds in 1907. Secretary of State Root presided at the meeting on December 11. Three vacancies in the board were filled by the election of Secretary of War Taft, Dr. Henry S. Pritchett and Dr. William H. Welch, of Johns-Hopkins University.

RAY WORK.—A cable dispatch from Berlin of December 9 says: "Doctors Reichenheim and Gehre announce that they have discovered new rays akin to the Röntgen rays. It was already known that cathode rays were generated in connection with Röntgen rays from the negative pole with platinum. Doctors Reichenheim and Gehre have discovered that anode rays emanate from the positive pole at the same time."

NOBEL PRIZES.—The Nobel prizes for 1906 in chemistry and physics were awarded respectively to Henri Moissan, of Paris, and Prof. J. J. Thomson, of Cambridge University, England. The prize in each case consists of a gold medal and $40,000 in money. A cablegram reports that Prof. Thomson will devote part of the cash prize for the furtherance of science at Cambridge, in this respect following the example of Lord Rayleigh.

MARCONI A SPIRITUALIST?—A cable dispatch to the New York *Sun* reports that Marconi has become interested in spiritualism through the Princess d'Antuni, of Rome. In an interview the Princess said: "I met Signor Marconi a few weeks ago at an entertainment given by the Marchesa Pinolecce. I spoke to him about spiritualism. He said he did not believe in it, so I invited him to come to my house and assist in a séance. There were only myself, Marconi and the medium. We formed a chain around a small table and without telling all the phenomena we obtained it is sufficient to say that when Marconi left he was a convinced spiritualist and quite determined to study the subject scientifically. He promised to put me in communi-

cation with Prof. Crookes. I am anxiously waiting to see whether the great inventor will succeed in finding an explanation of spiritualistic phenomena."

UNDAMPED ELECTRICAL OSCILLATIONS.—The discussion of Poulsen's method of producing undamped oscillations has brought forward the early work of Prof. Elihu Thomson in this field. A method apparently identical with that of Poulsen formed the subject of a United States patent granted to Prof. Thomson under date of July 4, 1893, on an application filed July 18, 1892. This method, which was practiced by Prof. Thomson about 15 years ago, has been referred to by him in articles and communications at various times since.

NEW YORK CENTRAL ELECTRICS.—The first regular electric trains on the New York Central Railroad went into operation on December 11, on the Harlem division, being Yonkers locals. Four passenger trains went into service, each made up of three cars, and these employed the third rail supply up to Highbridge, where the steam locomotive was attached for the remainder of the trip. Modest as the beginning was, it gave great and immediate satisfaction to the commuters on that section. The service is being increased to eight Yonkers trains and will gradually expand.

MARCONI AT VENICE.—A special cable dispatch from Vienna of December 7 says that a storm of resentment has been aroused by the speech delivered by Mr. William Marconi in Venice, in which he expressed the hope that when some day war should rage on the Adriatic, wireless telegraphy would inform the world with lightning speed of the victory of Italy. Newspapers as well as politicians deplore such references to a possible Austro-Italian conflict as tending to embitter the strained relations existing to-day between the two countries.

CONCRETE TELEPHONE POLES.—The Richmond (Ind.) Home Telephone Company's reinforced concrete telephone poles are attracting attention of telegraph and telephone companies in all parts of the country. Several poles were set in position late in November and the company is preparing to place a half a mile of the poles at once. Superintendent Bailey says he is deluged with letters from telephone and telegraph companies for information. As no patent is obtainable on the pole, Mr. Bailey is giving the information freely. He says the poles can be made and set for six dollars each. The mold and the material are moved along from hole to hole, and the pole is made on the spot where it is set. Reference to this type of pole was made in our issue for November 24.

ELECTRIC AUTOMOBILE ASSOCIATION.—An evidence of the renewed and growing interest in electric automobiles was afforded last week, during the show of the Automobile Club of America, by the foundation of the Association of Electric Vehicle Manufacturers, incorporated under the laws of the State of New York. The officers are: President, Col. George Pope, of the Pope Manufacturing Company; vice-president, Col. Geo. M. Studebaker, representing the Studebaker Automobile Company, of South Bend, Ind.; treasurer, M. L. Goss, of the Baker Motor Vehicle Company, of Cleveland; secretary, Robert McA. Lloyd, representing the General Vehicle Company, of New York. This new body will watch over the interests of the electric vehicle, and promote the art in every way possible.

U. N. E. A. MEETING.—Mr. C. M. Goddard, secretary of the Underwriters' National Electrical Association informs us that the annual meeting of the electrical committee of this association will be held in March, 1907, in New York City. The day and place of the meeting will be announced later. As usual, the provisions of the National Electrical Code as they now exist will be the principal matter for consideration, and it is requested that any desired change in, or addition to, the code, be forwarded to Mr. Goddard in Boston on or before February 1, 1907, in order that it may be printed in the bulletin, and the committee and other interested parties may thus have opportunity to consider the same in advance of the meeting. Final action on suggestions not received in season for consideration by the committee before the meeting can only be taken by unanimous consent. As heretofore, the meeting will be open to all interested, and such persons will not only be welcome, but are urged to be present and give the committee the advantage of their experience and advice.

AUTOMOBILE CLUB DINNER.—The eighth annual dinner of the Automobile Club of America was held at Sherry's, New York, on December 8, and was admirable in every respect except the dinner itself. Over 500 members and guests were present, and the speaking was excellent, far beyond the ordinary. A novel and successful feature was the performance of a long programme of music from the Cahill telharmonium plant, about a quarter of a mile away, through a battery of ten telephones with receivers, filling the big ballroom full of sound. The music was perfect in sweetness and richness, and of course gave all the personal touch of the performer at the distant keyboard. The music accompanied a series of moving pictures. Ordinary telephone circuits were used. Among the electrical men present were Dr. S. S. Wheeler, chairman of the building committee for the new club house; W. G. Bee, M. M. Belding, Jr., E. T. Birdsall, J. Burke, O. T. Crosby, M. Coster, P. T. Dodge, C. P. Geddes, A. G. Hodenpyl, H. A. Lardner, R. McA. Lloyd, T. C. Martin, M. Nathan, A. R. Pardington, F. H. Reed, A. L. Riker, J. Seligman and J. G. White.

ELECTRICAL TRADE SOCIETY.—The annual meeting of the New York Electrical Trade Society was held at the Imperial Hotel on December 11, Mr. John H. Dale presiding. The secretary's report shows that the past year has been a very successful one. The number of old and doubtful accounts handled have numbered 1,890 and amounting to $186,000. Of these 1,400 accounts, aggregating $147,000, have been paid through the instrumentality of the society's forms, making an average to each member of nearly $1,800. The hope was expressed that during the coming year more members would make use of the forms. The following officers were elected for the coming year: President, R. B. Corey; vice-president, W. E. Carmichael; treasurer, B. H. Ellis; secretary, Franz Neilson. Two new members were also elected to fill vacancies in the Board of Directors—Messrs. Franksen and Stout. C. C. Sibley was elected New York representative on the Board of Managers of the National Electric Trade Association. The business meeting was followed by a very enjoyable dinner during which music was rendered by a banjo quartet. There were no set speeches, but a number of informal addresses.

PROPOSED MUNICIPAL LIGHTING OF EAST ORANGE, N. J.—Mr. Henry Floy, consulting engineer for the East Orange City Council, submitted on Monday, December 10, his report on a joint municipal lighting and garbage plant for East Orange. The estimate of the report for a joint electric generating plant and garbage plant is $58,369. The underground distributing system would cost $359,648, and adding 10 per cent for emergencies and contingencies the total of the estimate amounts to $460,368. The proposed plan for street lighting is to replace the present gas lamp posts with electric lamp posts, each equipped with two high-efficiency electric lights placed about 3 ft. 6 in. apart, one projecting outward toward the road and the other inward toward the sidewalk. Such an arrangement would remove the objectionable shadows incident to the present street gas lighting arrangement. The present cost of lighting by gas the streets and public buildings of East Orange with about 1,550 lamp posts is about $45,000. Mr. Floy advocates 1,500 additional lamp posts, making a total of 3,000, all supplied with electric lamps, the annual cost of which would be $59,836 per annum. If a proposed plan to add 400 Welsbach lamps and to change open flame burners to Welsbach burners were carried out, the annual gas lighting bill for the 2,000 lamps would be $61,544; and with the addition of 1,500 more gas lamps the cost of gas lighting would be $91,044. The saving by municipal electric lighting is, therefore, estimated at about $31,000 per annum.

ELECTRICITY IN CANADA.—The returns show that during the past fiscal year the Dominion of Canada bought from the United States $2,367,497 of generating electrical apparatus and $981,097 of motors. The reports also include $318,090 of covered wire.

LONG WIRELESS.—In California on December 3, telegrams were exchanged by the Government wireless station at Point Loma with the Government station at Puget Sound, 1,200 miles away. This is the longest distance any wireless station on the Pacific coast has ever been able to transmit messages.

SUBWAY PIPE GALLERIES.—At a meeting of the New York Rapid Transit Commission last week it passed a resolution that all plans for proposed subways should have provisions for pipe galleries to contain the pipes for the necessary street service. The contracts to be advertised for the construction of subways will contain two sections: one for the construction of the subway proper, and the other for the construction of the pipe galleries. This will be done so that in figuring the rental for operating purposes the cost of building the pipe galleries will not be included.

ELECTRICITY IN CONSTANTINOPLE.—A Reuter telegram from Constantinople states that, with reference to the concessions for electric lighting and traction recently reported, a second irade extends the previous one in favor of the ordnance department (Tophaneh), which already exploits the gas works of the city and suburbs, by including in the concession the electric lighting of the Galata and Pera quarters of the city, and prolonging the same up to and including the village of Bebek, on the Bosphorus. Another irade has been issued granting to the Constantinople Tramway Company, which is almost exclusively owned by a German syndicate of bankers, the prolongation of its concession for a period of 75 years and giving it the power of introducing electric traction in place of horse traction. The existing concession expires in 1918.

TELEGRAPHY IN ALASKA.—Advices from Washington state that the success of the Government telegraphs in Alaska has been so great it probably will become necessary to extend the duplex line now working between Seattle and Sitka to the Sitka-Valdez section, in order to take care of the prospective heavy rush of business next summer. Reports reaching the chief signal officer show that in some instances the receipts during the past few months have exceeded by 100 per cent, and in many instances 50 per cent, those of a corresponding period last year. At present this system comprises a seventeen-hundred-mile stretch from Seattle to Valdez via Sitka, and fourteen hundred miles of land lines, terminating in a one-hundred-and-ten-mile wireless jump from St. Michael to Nome, the extreme point westward. It is possible that Congress will be asked to authorize the expenditure of the telegraph receipts toward extending the system this year from Fairbanks to Circle City. The cable ship *Burnside* is now at work extending a branch from the Juneau-Sitka cable down to Wrangell and Ketchikan, an important point, in the estimation of the chief signal officer, for reporting shipping.

NEW YORK TRAVEL.—The report of the State Railroad Commission for the quarter ended September 30 shows that in that quarter the average number of passengers carried daily on the electric traction lines in the five boroughs of the city was 3,529,142, of which 2,076,385 were carried in Manhattan. A total of 302,335,510 passengers were carried in the quarter, the figures for each of the boroughs showing a substantial increase over those for 1905. Practically all the gain in Manhattan was on the elevated and Subway lines. The surface lines showed a gain of only 28,568 passengers for the quarter, while the elevated showed an increase of 6,277,160, and the Subway 5,536,323. In Brooklyn the increase in passengers for the quarter amounted to 7,368,670, of which 6,539,943 were accounted for by the gain on the lines of the Brooklyn Rapid Transit. The average number of passengers carried daily on that company's lines were 1,099,031. On some days in the summer the number of passengers carried ran well over 2,000,000. On the heaviest day, in August, 2,153,234 cash fares were collected. The number of transfers issued in the entire city showed an increase of 31.2 per cent, compared with the corresponding quarter in 1905. In Brooklyn the number of transfers was nearly doubled.

AMSTERDAM EXPOSITION.—We are advised by the Netherland Chamber of Commerce in America, 68 Broad Street, New York, that "an international exhibition of motors and machines for professions and trades" will be held at Amsterdam, in the Palace of Industry, during August and September, 1907, by the Maatschappij Van Nijverheid (the Industrial Institute of Holland), which was founded in 1777. A circular issued by this institution states that "it is now being felt more and more keenly in Holland how necessary it is to prove to the craftsman the great advantage there is for him in the use of small motors and machine tools in his trade. As gas, benzine and other small motors are now being brought to such a state of perfection and in many places central electrical installations are being erected, the craftsman will be able to procure cheap machine installations, without which small trade can no longer compete. Up to the present, however, the Dutch craftsman has not been given the opportunity to see this advantage from practice. For this reason an exhibition has been projected exclusively for the craftsman, where the most modern motors and machine tools used in his trade may be seen." The Dutch Government has made an appropriation while the province of North Holland and the municipality of Amsterdam have already granted financial support. The secretary-general is Dr. Th. Müller Massis, Heerengracht 357, Amsterdam, Holland.

NEW YORK SUBWAYS.—Work on one or more of the new electric subway routes approved by the sub-committee of the Board of Estimate recently may be begun in April next, according to an estimate made by Chief Engineer Rice to the Rapid Transit Commission. This, of course, providing bidders appear in response to the commission's invitation. The question of where the stations on the new roads are to be located was brought up by Mr. Rice and has been referred to a committee. Practically all of the new stations are to go between cross streets and not on corners, so that there will be entrances and exits from two thoroughfares, as there are now in the case of the Fulton and Dey Street station of the Subway. Mr. Rice also suggested to the board that in future subways, cars be built without platforms and with doors at the side of the cars. The doors, he said, should be extra wide, and there should be two on each side of the car, placed between the end and the point at which the cross seats project from the wall. It is the belief of the chief engineer that these doors will permit of loading and unloading passengers with much greater rapidity than at present, while the absence of platforms will compensate for the loss of seating room incident to placing the doors inside the car proper. The doors will probably be opened and shut by compressed air, the levers to be operated by the guard standing between the cars.

CENSUS OFFICE REPORTS.—The director of the United States Census makes his annual report of the work of that bureau for the fiscal year ending June 30, 1906. In the operation of the bureau the total expenditures were $1,249,045 out of the appropriation of $1,455,340. The major expenditures for such a bureau is for clerical services. This amount appropriated last year was $745,760, the lowest in four years. The director recommends that he be authorized to fix a price for census publications for sale to the general public. While the practice in the distribution of these publications has been to put them into the hands of parties most likely to make use of them, there are many applicants for them who have no claim whatever for gratis copies. The scope of statistical inquiry of the census office has steadily widened, but the main burden of its work is that relating to population, industry and finance. Gradually the statistical agencies of the Government are differentiating their work to avoid duplication. Progress has been made in this respect within the last year or two. But still more important is the co-operation of the Federal census office with State and city officials in the preparations of statistical returns, the five-year census of manufacturers by States and the census of municipal indebtedness. A volume has recently been issued comprising the complete series of reports on electric public utilities—lighting, traction, telephony, fire alarms, telegraphy, etc.

WIRELESS IN NEW YORK.—Work on a new wireless telegraph station in the Brooklyn Navy Yard has been started. The new building will be of brick and will cost about $8,000. It will be equipped with two masts and will be about five times the size of the station now being used.

IN CUBA.—Gov. Magoon has prepared a decree granting a concession to the Commercial Cable Company, after which the cable will be landed immediately, unless some new law point is brought up to cause delay. Gov. Magoon has also ordered that six new wireless telegraph stations be established on the island.

ON ITALIAN WARSHIPS.—Advices from Rome state that Admiral Mirabello, the Minister of Marine, has decided to apply to the Marconi wireless telegraph systems already in place on all warships in the Italian navy the discovery of Prof. Arton, which enables electric waves to be sent in any direction desired. Mr. Marconi and Prof. Arton have agreed to this installation.

RAILROAD TELEGRAPH OPERATORS.—According to advices from Washington, the general misgiving as to the efficacy of the precautions taken by railroads for the safety of their passengers, which resulted from the wreck on the Southern Railroad near Lynchburg, Va., on November 29, in which President Samuel Spencer and three guests lost their lives, is reflected in a bill introduced in the House by Representative George A. Pearre, of Maryland. It provides that telegraph operators engaged in signaling trains by the block system shall be required to pass an examination prepared by the Inter-State Commerce Commission, and receive from that body a diploma attesting their efficiency before receiving a place. The bill also provides that operators shall not work longer than eight hours of the twenty-four, unless after ten hours' consecutive rest.

IMPROVING RAPID TRANSIT.—Congressman Herbert Parsons, chairman of the New York Republican County Committee, appointed a committee of thirty-five to "examine into and report upon present conditions of transit, the means under way for bettering transit facilities, and any plans and legislation that are needed." Mr. Parsons' action resulted from a resolution passed by the County Committee based upon Governor-elect Hughes' promise to give the city better transit facilities. The new committee is thoroughly to investigate the present situation first. It will take up each of the lines proposed by the Rapid Transit Commission. It is generally understood that bills emanating in the committee will be pushed through the Legislature with all the power of the Republican machine behind them. Great results will not be noticeable for some time to come, as at least six years must elapse before a subway can be built. It will be within the province of the committee, however, to suggest legislation as to the operation of all present systems in the city, including surface, subway and elevated roads, and some immediate improvement may be brought about on these lines. Everything has now been electrified except a few miles of old crosstown horse car lines.

POWER IN MANUFACTURES.—The reports of the United States Bureau of the Census on power in manufactures go back to 1870. In that year the amount aggregated 2,346,000 hp; in 1880 the total was 3,411,000, an increase of 45 per cent; by 1890 the total had reached 5,955,000, or a further increase of 75 per cent; in 1900 the total was 10,410,000, an increase of 75 per cent; in 1904 the aggregate was 14,465,000, or an increase in that short period of 39 per cent. This latter increase, if continued, would give a total of 93 per cent for the decade. Prior to 1890 water and steam were practically the only sources of power. Since then gas and electric power have made enormous advances, amounting during the decade from 1890 to 1900 to about 1,400 per cent for gas, and 1,900 per cent for electric power. At the present time the report shows that steam, with 10,665,000 hp, accounts for 74 per cent of the total. Water power, amounting to 1,648,000 hp, represents 11.5 per cent. Electricity accounts for 1,138,000 hp, while the remainder is divided between gas, miscellaneous powers and rented power, where electricity again comes in. In 1870 water power accounted for almost one-half of the total, and during the 35 years since that date it has increased only 46 per cent. The proportion to the total represented by steam power showed a steady increase until 1890, but has dropped since then.

HELPFUL CITY LIFE.—President Finley, of the City College of New York, in a recent address at the students' club house extolled the virtues and charms of city life. "Growth of urban centers is a commonplace fact," he said. "New York, Philadelphia and Chicago, it is prophesied by Mr. Wells, will some day have a population each of 40,000,000. Even staid old Plymouth has put in a trolley line to carry her John Aldens and Priscillas to market and to church. Once everybody lived in the country; now everybody lives in the city—or intends to move in in the spring. The cities of the past, with all their wickedness, and all the wretchedness they have caused, have been, after all, the stepping stones on which civilization has picked its way from its Asiatic cradle to the pillar of Hercules." President Finley said he loved city life and did not sympathize with those who were constantly harping on the joys of the simple life. He had tried both, he said, and knew whereof he spoke.

WIRELESS FOR ARMY.—It is stated from Washington that the successful use of wireless telegraphy in the movement of battleships caused the officials of the War Department to cast about for a wireless outfit which should be at once compact and portable, and which could be installed in the field in the shortest possible time. Experiments conducted by the signal service within the last few months have resulted in the construction by the Government of a number of outfits of that kind, and they are now being distributed among the various commands. The high cost of wireless material led the Government to make its own appliances, but it is stated that they embody the principle elements of the latest improvements of apparatus of this character. Although it is felt that these outfits ultimately will be improved upon, they are already capable of doing efficient work. They are so constructed that they easily may be transported on the backs of three horses or mules, and may be set up in twenty minutes. They can transmit messages about one hundred miles, and a valuable feature is that they will not interfere with each other in their operation. The Coast Artillery stations will be fitted up with the same outfits, from which communication may be had with ships at sea and transmitted to the field if necessary. When the army of pacification went to Cuba it took along a couple of wireless outfits, and reports have reached the department that their operation has been completely successful.

ABOLITION OF TELEGRAPH FRANKS.—The Postal Telegraph Cable Company has resolved to discontinue franking pricileges after Jan. 1, 1907. Transportation given away by the railroads in the days of the free pass graft was without consideration, but most of the telegraphic franking is for value received. The company's action does not operate against this latter class of business. It has a number of contracts with railroads, chiefly among them the Pennsylvania, for the operation of wires along its lines, which call for certain franking privileges to the railroad officials. This free business would not be affected, nor any other franking privileges granted by the company by similar business arrangements. The order chiefly affected the thousands of gratuitous franks issued annually by the company as a courtesy to friends and large customers of the company. These franks are in the form of little books containing thirty-two stamps, each good for twenty words, with a reply when attached to a message. The order took the form of the following resolution, which was passed by the Board of Directors and made public by President Mackay: "Resolved, That owing to changed conditions it has been found necessary to stop all free transmission of messages, and this company will absolutely discontinue its free list on and after January 1, 1907, and no free service whatsoever will be performed thereafter. Outstanding franks will be honored to and including December 31, 1906." The Western Union has not taken up the matter of franking and is not likely to make any change for the present.

The Hydro-Electric Plant of the Belton Power Company.

By GEORGE WRIGLEY.

THE generating plant of the Belton Power Company is located on the Saluda River, at a point about seven miles east of the town of Belton, S. C. The river, at the location of the plant, encounters a series of rapids, and the hydraulic development adopted utilizes to the best advantage the fall due to these rapids.

The Saluda River, one of the tributaries of the Congaree, rises in the foothills of the Appalachian Mountains and drains a basin of approximately 534 square miles above the Belton dam. The absolute low water flow of the river was found to be 270 cu. ft. per second at the plant site. The normal flow does not, however, run lower than 600 cu. ft. per second for 90 per cent of the time. As the principal users of the power are cotton mills, operating for eleven hours a day, the impounding reservoir was designed with a capacity best suited to this character of load.

The hydraulic development consists essentially of a dam and reservoir, a canal, forebay, penstocks and wheels, from which the water is discharged into the tail race, and returns to the river.

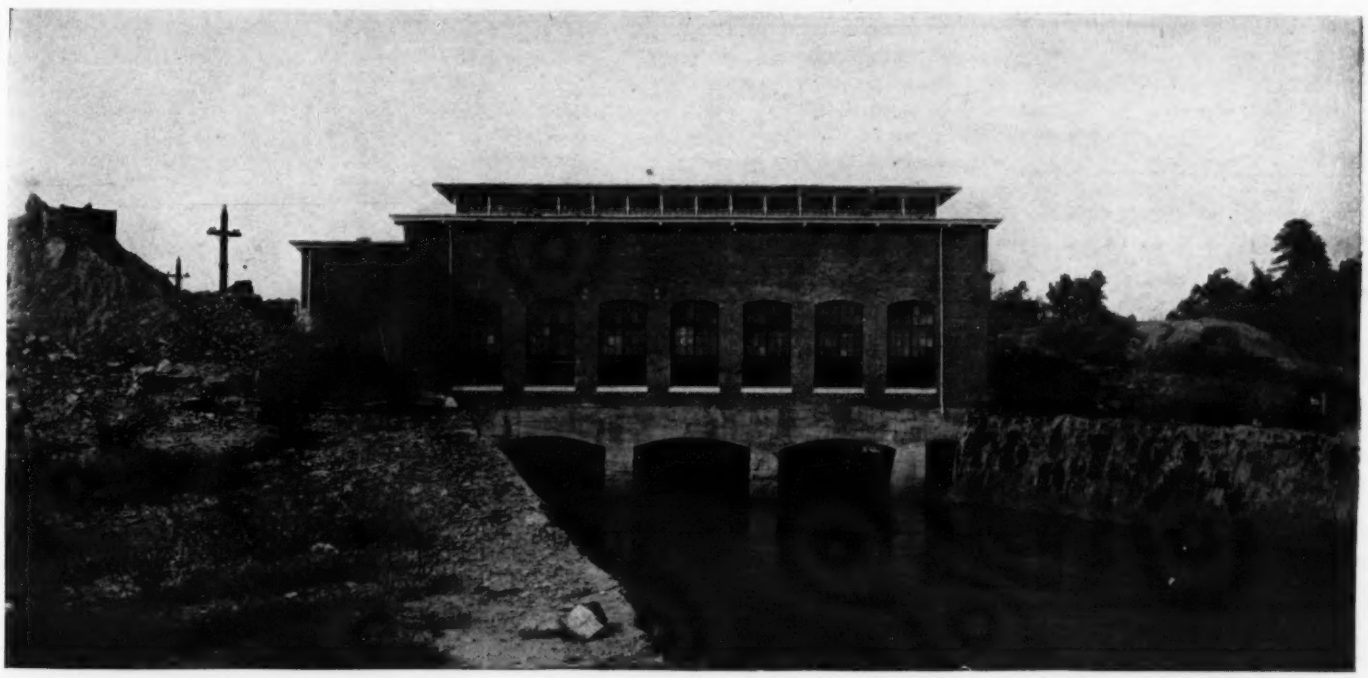


FIG. 1.—POWER HOUSE AND TAIL-RACE.

The dam is a structure of cyclopean concrete, with a spillway 319.5 ft. long, one abutment 94 ft. long and one abutment 177.5 ft. long, the latter containing the head gates, trash racks and sand gates, with the operating mechanisms for these devices. A floating log boom protects the trash racks from injury by heavy driftwood.

The foundations for the entire dam and the anchorages for the abutments are laid on the bed rock. An ample supply of granite was found in the excavations and the near proximity, and this stone was used in the construction of the dam and other parts of the plant. Southern States Portland cement was used throughout in the concrete work, the standard mixture being one part of cement to two and one-half parts of sand and five parts of two-inch mesh broken stone.

The entire dam is faced on the upstream side with a layer of massive granite, approximately two feet in thickness. This face of the dam is vertical, the batter being on the downstream side.

The canal, conveying the water from the head gates to the forebay, is parallel to the general direction of the river and has a length of 816 ft. One wall of the canal consists of a cut in the hillside; the other, or river side wall, being formed, for a part of its length, by an earth fill over a concrete core wall, and is protected, where necessary, with stone filling. The cut has a slope of one to one, and the fill a slope of one and one-half to one.

Immediately below the head gates in the river side wall of the canal, is placed an auxiliary spillway, having an elevation of one foot more than the main spillway, and sufficient area to discharge all of the water which the head gates are capable of admitting. This spillway protects the canal and forebay from overflow in case of a sudden shutdown of the water wheels, from any cause.

The forebay, like the main dam, is built of cyclopean concrete and contains a second pair of trash racks, the penstock gates and the air vents. The penstocks are, in reality, simply extensions of the wheel casings, and are securely anchored into the forebay masonry. The penstocks and wheel casings are made of three-eighths-inch boiler plate, single riveted.

It was found expedient to run the county road immediately over the wheel casings, so the penstocks and wheel casings were encased in a mass of concrete masonry, forming a practically solid structure from the forebay to the power house wall. Each of the penstock gates is fitted with a priming or filling gate to facilitate operation. Manholes in each wheel casing provide access for inspection and adjustment.

Each of the main prime-mover units consists of a set of three, thirty-nine-inch inward flow turbines, fitted with cylindrical gates and having an aggregate capacity of 1,700 hp per unit at full gate when operating under 35 ft. head and running at a speed of 200 r.p.m. Three of these units are installed, each unit being directly connected by a face plate coupling to a 1,000-kw generator. A 15-in. turbine is installed for driving one of the exciter units and an 18-in. turbine for driving a small alternating-current generator.

The speed of each of the main units is controlled by a Holyoke "Improved" governor, operating on oil pressure, and furnished complete with oil tanks and pressure pump, the pump being belt-driven from the shaft of the prime-mover unit. A small compensating Woodward governor is installed for each of the 15-in. and the 18-in. wheels.

Draft tubes of ample cross-section convey the water from the wheels to the tail-race, the ends of the tubes being well submerged and the tail-race excavated for a sufficient depth immediately below the tubes to prevent foaming. The normal elevation of the tail-race water is 36 ft. lower than the crest of the spillway of the main dam. The tail-race is approximately 338 ft. long, and is lined with massive stone masonry set in cement.

The generating machinery is placed in a substantial brick and steel building, 83 ft. long and 35 ft. wide and resting on the concrete arches and bed rock foundations. The building is provided with ample window openings and has a large monitor in the

roof, giving good light and ventilation. The floor of the power house is served by a Niles-Bement-Pond traveling crane of 15 tons capacity. The step-up transformers are placed in a separate room at one end of the main building. This room contains also the lightning arresters, oil switches, etc., and is separated from the main building by a fire wall fitted with an automatic fire door placed on a level with the switchboard gallery.

The main electrical generating units consist of three 1,000-kw, three-phase, 2,300-volt, 60-cycle, revolving-field generators, each directly coupled to one set of three water wheels and running at a speed of 200 r.p.m. The generators are of the open frame type of construction and are furnished with cast-iron bases and have the shafts extended for the reception of an exciter driving pulley. The armature windings are of the distributed type, with three slots per pole per phase, and are star-connected.

The generators are guaranteed to have the following characteristics: Efficiency, full load, 95 per cent; three-fourths load, 94 per cent.; one-half load, 92 per cent; voltage regulation from full non-inductive to no load, 8 per cent.

A 100-kw, three-phase, 60-cycle generator, running at a speed of 600 r.p.m., and generating current at 2,300 volts, is directly coupled to the 18-in. water wheel. This unit is used at night for lighting service, after the main power generators are shut down. A 5.5-kw exciter is provided for this generator and is driven from a pulley on the extended shaft of the generator.

The plant is equipped with two main exciters, one of 55 kw capacity directly coupled to the 15-in. water wheel and running at a speed of 625 r.p.m., and one of 58 kw capacity at 925 r.p.m., the latter so arranged that it can be driven by a belt from a pulley on the shaft extension of either one of two of the main generators. The water wheel-driven exciter gives somewhat better voltage regulation and is used in normal operation, the belted machine being held as a reserve. Each of the exciters has sufficient capacity to excite all of the main generators, under the extreme conditions of load and power factor met with in the operation of the plant.

The cables connecting the generators with the switchboard are insulated with varnished cambric and are lead-covered. These cables are laid in impregnated fibre conduit, set in the concrete floor of the station. The switchboard is mounted on a gallery at one end of the power house, and immediately in front of the transformer room. The gallery is of sufficient height to enable the operator to have an unobstructed view of all the machinery.

The switchboard consists of four generator, two exciter-generator and two step-up transformer panels. The material of the panels is blue Vermont marble and the instruments are nickel finished. The panels have a uniform height of 62 in. with a sub-base 28 in. high, and are 2 in. in thickness. All of the generator panels are 24 in. wide and the transformer panels are 16 in. wide.

The oil switches for the generator and transformer panels are placed in separate cells mounted on a gallery in the transformer room (this gallery being a duplicate of the one in the main room and placed on the same level with it). Operating rods run through the dividing wall and connect the oil switches with their respective mechanisms on the face of the switchboard.

The panels are equipped with horizontal edgewise instruments and all devices desirable for the flexible operation of the plant. The generator switches are non-automatic, the transformer switches being automatic with time-limit relays.

Installed in the transformer room are six water-cooled 500-kw transformers, which raise the potential of the system from 2,300 to 22,500 volts. These transformers are installed in two banks of three each, and are delta-connected on both the low and high-tension sides. The transformers have the following guaranteed characteristics: Full load efficiency, 97.7 per cent; regulation from full non-inductive load to no load, 1 per cent. The water for cooling the transformers is drawn direct from the penstocks. As this water contains, at times, a considerable quantity of silt, liable to precipitation in the cooling coils, a pressure pump is installed for blowing out the sediment at intervals.

Each bank of transformers is connected to a set of high-tension bus-bars, which are in turn connected through the medium of air break disconnecting switches to the one outgoing line. During normal day load operation both banks are connected to the line and operated in multiple, but at night only one bank is retained in service.

The lightning arresters also are placed in the transformer room and are equipped with choke coils and disconnecting switches. The arresters are of the multiplex type, of multi-gap construction, with graphite resistance in series with the gaps.

The three conductors of the transmission line leave the transformer room through terra-cotta tiles, set in the wall at an angle to prevent the entrance of rain. From the generating station, the first section of the transmission line is carried to a junction point, from which the lines to Belton and Williamston diverge. This first section of the transmission line is 4.1 miles long and consists of three cables of 165,160 cir. mils each. The line from the junction to Belton is 4.4 miles long, with 103,800 cir. mils cables, and the line to Williamston, 5 miles long, with 82,340 cir. mils cables. All of the power conductors are of aluminum, seven-strand cable. Joints were made in the cable, where necessary, with flat aluminum tubes, of such size as to snugly fit the ends of the cable and firmly secured by two complete twists.

The power conductors are placed in the form of an equilateral triangle with a distance of 48 in. between centers. Poles are spaced 120 ft. apart on the levels and the average height of the lower conductors above level ground is 30 ft. The pole line is carefully graded in height, by using long poles in the low places and short ones on the crests of ridges. The poles are of pine, impregnated by vacuum process with creosote. The cross-arms are of pine, have a cross-section of 5 in. by 6 in., and are also impregnated with creosote. The cross-arms are set in 1½-in.

FIG. 2.—CANAL AND DAM.

gains, and are secured to the pole by two ⅝-in. bolts. Each cross-arm is braced by two 1½ in. by ¼ in. braces 30 in. long, secured to the cross arm by ⅜-in. carriage bolts, and to the pole by a ½-in. by 5-in. lag screw. All braces and bolts are thoroughly galvanized.

The top insulator pin is bolted to a cap casting, fitting over and securely bolted to the pole top. All of the pins are of the porcelain base type, Locke No. 24 being used for the top and No. 19 for the cross-arm construction. Each pin is secured by means of a ¾-in. galvanized steel bolt. The insulators are of the single petticoat type, have a diameter of 6¾-in. and an over-all height of 5¾ in., and are made of brown porcelain. The power conductors are fastened to the insulators by means of tie wires of solid No. 1 B. & S. soft aluminum wire.

An improvised form of disconnecting switch is installed at suitable intervals along the transmission line, so that in case of necessity, or for testing purposes, the line may be sectionalized. The switch consists of two strain insulators, joined together at a suitable distance apart by a substantial wood framing, and an aluminum clamp. Each cable end is dead-ended to one of the strain insulators, the loose ends being joined together by the clamp. These switches are bolted, two to the cross-arm and one to the pole top at right angles to the cross-arm. They are, of course, suitable for operation only when the lines are not carrying current.

Strain insulators are used at such points where it was found necessary to change the direction of the line, a special form of iron brace being used for the top insulator, and where the angles were severe, double cross-arms were used for the lower wires. At such points the poles are securely guyed to anchorages, and

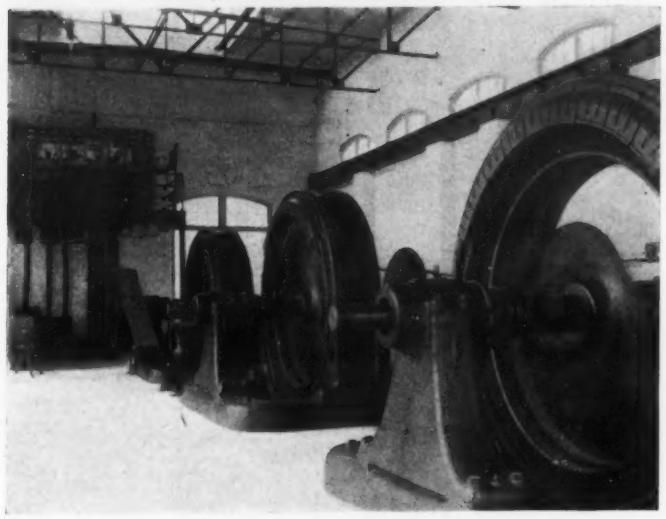


FIG. 3.—INTERIOR OF POWER HOUSE.

the line is head guyed at approximately every tenth pole. Right-of-way was cleared and is maintained for a sufficient distance on each side of the line to prevent injury from falling trees or limbs.

The telephone wires are placed on the same poles as the power conductors and 4 ft. below them. No. 10 B. W. G. galvanized steel wire is used for the telephone lines, supported on standard glass insulators and wooden brackets and transposed at every fourth pole. An auxiliary telephone line is also installed, running on separate poles and by a different route and right-of-way. In addition to the instruments in the power station, sub-stations and office, a portable set is provided for each of the linemen.

Lightning phenomena in this section of the country are very severe, and a grounded guard conductor is installed to assist in eliminating disturbances on the transmission line. This guard conductor consists of a 3/16-in. galvanized steel cable, supported by the lower cross-arm to which it is secured at the side of the pole, its position being practically at the center of the base of the triangle of power conductors. The guard conductor is grounded thoroughly at every sixth pole.

One sub-station is located at the town of Belton, the other at

FIG. 4.—EXTERIOR OF POWER HOUSE.

Williamston. The sub-station at Belton contains three 667-kw water-cooled transformers, stepping down from 22,500 volts to 600 volts. These transformers supply power to the Belton Mills. The primaries of the transformers are connected in delta, the low-tension secondaries being connected in star with the neutral grounded, so as to obviate the possibility of the high-tension current entering the mill, in the event of a break-down in the insulation of one of the transformers. In a separate room of this sub-station are installed two 25-kw transformers, supplying current at a potential of 2,300 volts, three-phase, for the lighting of the town and the operation of small motors. These transformers are connected "open delta" on both the high and low-tension sides. A 25-light, air-cooled, constant-current transformer supplies current at 6.6 amperes for the operation of the series street arc lighting system.

The Williamston sub-station is practically a duplicate of that at Belton, except that the apparatus is smaller. Three 333-kw transformers supply power at 600 volts to the Williamston Mills, and a single 25-kw transformer is installed for the lighting of the town.

Each of the sub-stations contain an automatic, triple-pole oil switch, each pole mounted in a separate cell and operated together from one shaft and mechanism. These switches are operated by means of trip coils actuated by time limit, overload relays, Multiplex lightning arresters, duplicates of those at the power station, are installed in each of the sub-stations.

Both the Belton and the Williamston Mills are equipped with complete steam plants, having been so operated before the advent of the electric power. These steam plants are now held as reserves and are ready for prompt service in the event of an accident to the electric system. The shafting of the mills is so arranged that the drives can be changed from electrical to mechanical, or vice-versa, in a very short time.

The group electric drive is used in both mills, induction motors of standard speeds and varying in size from 50 to 300 hp being installed. The load is practically constant for 11 hours during the day; and as there is no night work in the mills, only the comparatively small lighting load of the towns is carried during the night.

The water-wheels, together with the gate irons, penstocks, draft tubes, governors and other accessories were furnished by the Holyoke Machine Company, of Worcester, Mass. The entire electrical equipment, including the apparatus for both the sub-stations and the generating station, was furnished and installed by the General Electric Company. This same company furnished and installed also the electrical equipment in both of the mills. The complete hydraulic and electric plant was designed by, and constructed under the supervision of Mr. J. E. Sirrine, of Greenville, S. C.

Mr. John B. Adger is president of the power company, and Mr. William Harrison Trammell is the general superintendent. The company maintains its executive offices at Belton, S. C. The plant was put in operation on November 25, 1905.

Tests of Incandescent Lamps.

BY PROF. L. B. SPINNEY.

THE present agitation of the subject of high-efficiency incandescent lamps has very naturally emphasized the shortcomings of existing low-efficiency types. The study of lamp efficiencies has received an impetus greater perhaps than it ever before experienced, the results of which have been a larger interest in the behavior of the carbon filament lamp and a more widespread knowledge of its characteristics.

That such lamps are inefficient even under most favorable conditions has, of course, long been recognized even by those having the most superficial knowledge of the subject, and it is not impossible that a general recognition of this fact may be responsible for much of the careless buying and selling of lamps improperly made and poorly selected, and the use of lamps at efficiencies which are absurdly low even in the light of this knowledge. That this attitude toward the carbon filament lamp must necessarily follow a general recognition of its inefficient nature is, however, not apparent. On the contrary, it would seem that the reverse should be true.

The fact that the practical operation of the carbon filament lamp requires the expenditure of, let us say, 3.1 watts per candle-power is scarcely to be regarded as justifying the use

of lamps which consume twice that amount of power. Nevertheless, the most casual observation will convince one that such waste of power is not at all uncommon. Lamps that have been in service so long that their efficiencies have fallen to a low value and lamps rendered inefficient by being operated at voltages below that for which they were designed, are to be found perhaps upon every commercial circuit.

It is not here contended that the use of low-efficiency lamps is not in certain cases justified. These special cases are, however, comparatively few in number and limited perhaps to certain classes of sign and decorative illumination, the circuits for which are difficult of access and the service rendered of such nature that the brilliancy of the units employed is of secondary

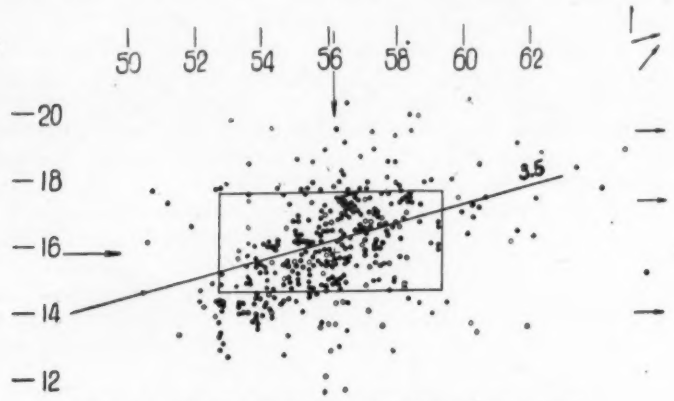


FIG. 1.—TARGET DIAGRAM, 3.5-WATT, 16-CP LAMPS.
Of the 138 lamps represented, 90 fall within the target.

importance. It will be understood that the present discussion applies to illuminating circuits in which the great desideratum is the illumination of the surroundings amidst which the lamps in question are placed.

It must be conceded that in the general case, so long as the life of the lamp chosen is not so short as to render the cost of renewals excessive, the high-efficiency lamp is the more desirable. From the customer's standpoint the question scarcely admits of argument. To the central station manager the real merits of the case must appeal quite as strongly, since his aim should be to satisfy his customer, and the satisfied customer is the one whose premises are well lighted at a reasonable cost.

The consideration of lamp efficiency is of special importance in those cases in which the electric lamp is competing with some other form of illuminant. Under such circumstances the customer is apt to keep strict account of the meter readings, and at the same time regard with critical eye the general illuminating effect produced by the lamps installed. It behooves the station manager to see that on such circuits lamps of reasonably high efficiency are employed, and that such lamps are renewed before they become dim and inefficient.

The percentage of lamps used on commercial circuits which are defective in selection or in vacuum is unquestionably large. Lamps which are either poorly selected or improperly exhausted are, of course, undesirable, while a low-vacuum added to an efficiency below that at which the lamp is rated is, to say the least, an unfortunate combination.

In view of the general interest which these matters are awakening it is believed the results of the lamp tests described below will be received with some attention and may not be altogether uninstructive, since they emphasize the need of exercising care in the purchase of lamps in the general market and point indirectly to the desirability of proving for one's self the quality of lamps purchased.

The tests referred to were made at the Iowa State College and were carried on for the purpose of determining, among other things, the care with which commercial lamps are manufactured and selected. The tests were undertaken in the interest of the lamp users of Iowa and the results will be published in the form of a bulletin.

Something over 1,000 lamps, representing 32 different makes, have been studied. These lamps range in rated candle-power from 1 to 50, in rated voltage from 50 to 225, and in rated consumption from 3.1 to 4 watts per candle-power. The majority, however, are rated 16-cp lamps, and excepting in the vacuum tests these only are included in the tables, diagrams and discussions given herewith.

The lamps are presumably new lamps and were secured through the co-operation of 41 different electric light plants or light users, 38 of these being located within the State. They were received in lots of from six to eighty-two lamps, the average number of lamps from each source being seventeen, and in but five instances did the number of 16-cp lamps of any one kind received from one source exceed twelve. The greatest number of 16-cp lamps of one kind sent in from one plant was 32.

It will be seen, therefore, that the series of lamps tested represents fairly well the lamps commercially distributed throughout the State. The tests made include tests for initial mean horizontal candle-power, initial power consumption, and vacuum.

TABLE I.
Average initial mean horizontal candle power and wattage of all 16-cp lamps tested.

		Results of tests—averages	
Rated consumption.	No. of lamps tested.	Mean horizontal candle-power.	Watts per m.h. c.p.
3.1	119	16.26	3.11
3.5	378	15.8	3.56
3.6	11	17.50	3.55
3.8	23	15.00	4.15
4.0	15	15.12	4.26

The mean horizontal candle-power measurements were made upon a standard Reichsanstalt photometer fitted with a Lummer-Brodhun screen. The secondary standards used were secured from the Electrical Testing Laboratories of New York City. Stationary standards were used and the test lamp was rotated at approximately 180 r.p.m.

The power measurements were made by means of a standard portable direct-current voltmeter, checked by a semi-portable laboratory standard, and a portable direct-current ammeter checked by means of the standard lamps which were certified as to current consumption.

The power used was obtained from a 60-cell, 120-amp.-hour storage battery for all tests excepting those of the 220-volt lamps.

For vacuum tests the induction coil method was employed. A lamp was classified as medium when the blue Geissler discharge was distinct, yet not so full and complete as in those lamps classified as low.

TABLE II.
Selection percentages for all 16-cp lamps tested.

Kind of lamp.	No. tested.	No. falling with in target.	Selection per cent.
All 3.1-watt lamps	138	90	65.1
All 3.1-watt lamps, new series	118	79	67.0
All 3.5-watt lamps	385	238	62.0
All 3.5-watt lamps, new series	335	212	63.3
All 3.6-watt lamps	11	2	18.2
All 3.8-watt lamps	23	13	56.5
All 4.0-watt lamps	15	9	60.0

In the results as set forth in the diagrams and tables two lots of lamps are included. In the tables they are distinguished as

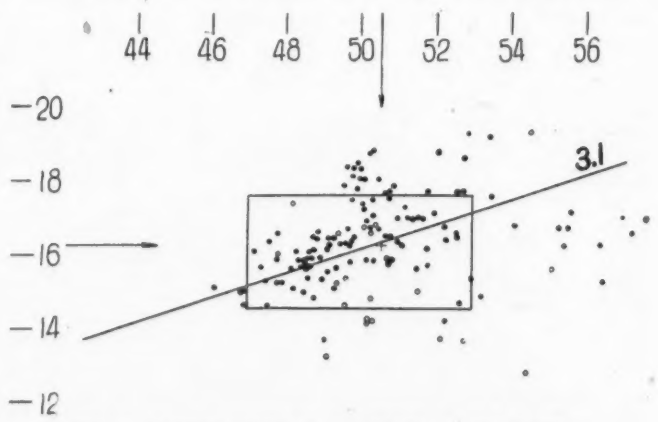


FIG. 2.—TARGET DIAGRAM, 3.1-WATT, 16-CP LAMPS.
Of the 385 lamps represented, 238 fall within the target.

the old and new series. In the diagrams the lamps of the new series are represented by solid circles or dots, those of the old series by open circles.

The lamps of the old series were tested in part by four different individuals. The lamps of the new series were all tested for initial candle-power and wattage by one individual.

The general results of the tests are set forth in the accompanying tables and target diagrams. The targets, as drawn, correspond to the limits of 1½ cp above and 1½ cp below the rated candle-power, and 6 per cent above and 6 per cent below the rated wattage.

TABLE III.
Results of Vacuum Tests.

Kind of lamp.	No. tested.	Vacuum— High.	Medium.	Low.
All kinds	651	496	75	80
Percentages	100	76.1	11.5	12.3

The general results of these tests may be summarized as follows:

1. There is a wide variation in the incandescent lamps to be found upon the market: (*a*) In selection; (*b*) in candle-power; (*c*) in wattage; (*d*) in vacuum.

2. About 62 per cent of the 16-cp lamps tested were well selected.

3. About 76 per cent of these lamps were properly exhausted.

The carbon filament is destined to give way in the near future to filaments of higher efficiency. Consumers have been taught to expect larger returns per kw-hour paid for, and central station managers realize that successful competition with other modern illuminants is fast becoming impossible with old type lamps. The pressures coming from these two sources act in the same direction and the demand for a high-efficiency incandescent lamp has become imperative.

It must be gratifying to any one interested in electric lighting to see how effectually this demand is being met. The high-efficiency lamp has been so promptly forthcoming that one is easily persuaded that it is probably a question of but a short time when it will quite supersede the older types.

It is needless to remark, however, that the old-type carbon filament has not as yet been largely superseded by the newer types, nor will it be immediately displaced. We must content ourselves to continue in its use for some time to come. It should, therefore, be borne in mind that as found upon the market this lamp is a variable quantity, and that it is worth while to go to the trouble of proving the quality of lamps purchased.

The Proper Size and Voltage of Storage Battery Cells for Electric Automobiles.

BY FRANK B. RAE.

IN the electric automobile, as placed upon the market by various makers, the number of cells used varies, for the same approximate weight of vehicle while the weight of battery in proportion to vehicle weight is about the same in each case. This difference in the number of cells employed and therefore the voltage available is an expression of the motor designer's preference,—governed somewhat perhaps by the floor space allowed for the cells,—the capacity being made up by the increased vertical dimension.

From the standpoint of the selling company, the smaller number of cells has an advantage in that the first cost is less for a given capacity, but conditions of operative cost and maintenance should also be considered.

The proportion of battery weight to total weight of a vehicle is generally about 40 per cent and should not exceed this; thus, if the total weight is taken as 2,000 lb. or 1 ton, the battery should not exceed 800 lbs. The number of cells adopted as standard by several vehicle makers is given in Table I, with weights, output and relative costs, made up from the catalogue of one of the well-known types of storage batteries, and in which an average working voltage of 2 volts per cell is assumed:

TABLE I.

No. of cells.	Plates.	Voltage.	Discharge 4 hour rate.	Total amp.-hours.	Capacity watt-hours.	Total weight.	Cost.
12	19	24	63	252	6050	725	$312
24	11	48	30	120	5760	740	324
32	9	64	24	96	6125	775	355
40	7	80	18	72	5750	770	352

Upon the assumption that the maximum speed of four 2,000-lb. vehicles, each equipped with one of the batteries, is 17 miles per hour in each case, also that the resistance to traction is 40 lbs. per ton, and the average motor efficiency 80 per cent, then the horse-power input to propel the vehicle at speed will be $\frac{17 \times 1 \times 40}{375 \times 80} = 2.26$ hp, or 1,690 watts, or $\frac{1{,}690}{17}$, approximately 100 watt-hours per ton-mile. Neglecting the watt-hours lost in starting and accelerating, the vehicle will have an apparent total mileage for the number of cells used, as shown in Table II.:

TABLE II.

No. of cells.	Capacity watt-hrs.	Vehicle miles.	Miles per lb. of battery.	Cost÷by miles per lb.
12	6050	60.5	12.	26
24	5760	57.6	12.85	26
32	6125	61.25	12.65	28
40	5750	57.5	13.41	26

The difference so far shown as bearing upon the selection of the number of cells to be used, having the same approximate rates of miles per pound to cost of cells, slightly favors the 12 cells arrangement, in that the selling company may equip the vehicle with a battery of 12 cells for $40 to $50, less than with any other number of cells.

The efficiency of any storage battery may be taken generally at 80 per cent, based upon a discharge at the eight-hour rate. The efficiency is much lower than this at higher rates of discharge and agrees closely with the following figures, which are given in per cent of capacity at the eight-hour rate:

8 hour	100%
7 hour	96
6 hour	92
5 hour	86.5
4 hour	80
3 hour	72
2 hour	61
1½ hour	53.5
1 hour	46

The electric vehicle battery, however, is discharged at approximately the four-hour rate; therefore if the efficiency at the eight-hour rate is 80 per cent, at the four-hour rate it is only 64 per cent and for the output as given in Table I, the input or charging watts will be shown in Table III:

TABLE III.

No. of cells.	Output in watt-hours.	Input in watt-hours.
12	6,050	9,450
24	5,760	9,000
32	6,125	9,560
40	5,750	9,000

As the operation of the vehicle at the speed taken requires 1,690 watts, the average curent consumption from the several batteries will be as follows:

For 12 cells, 70.5 amps.; 24 cells, 35 amps.; 32 cells, 26.4 amps., and 40 cells, 21.2 amps., which is slightly in excess of catalogued four-hour rate of discharge.

The average voltage of charge or counter e.m.f. of the cells may be taken at 2.3 volts per cell, hence the e.m.f. of 12 cells will be 27.60 volts; 24 cells, 55.25; 32 cells, 73.60, and 40 cells, 92. volts; and the hours required to charge the batteries to the capacity given are the watt-hours of input divided by the watts input, or approximately five hours in each case.

The internal resistance of any cell irrespective of its size when discharged at the four-hour rate is practically $\frac{.09}{D}$ ohm where D is the four-hour rate in amperes. Therefore, we have for the several batteries the following internal resistance:

Twelve cells, .0153 ohm; 24 cells, .0652 ohm; 32 cells, .1087 ohm., and for 40 cells, .1700 ohm. The volts drop across the batteries due to such resistance is the current times resistance, or for the 12 cells, is 1.08 volts; 24 cells, 2.38 volts; 32 cells, 2.76 volts, and for 40 cells, 3.61 volts.

The volts that must be impressed at the terminals of the battery to overcome the counter e.m.f. of the cells and the drop due to internal resistance are therefore the sum of the two, or for the 12 cells, is 28.68 volts; 24 cells, 57.63 volts; 32 cells, 76.36 volts, and for 40 cells, 95.61 volts.

Where vehicles are charged at a public garage, the voltage of the charging mains varies from 110 to 125 volts and may be taken to average 115 volts. While it is possible to charge vehicle batteries equipped with 12 or 24 cells in series of two or more, this rarely occurs in practice as such vehicles are seldom simultaneously available. Therefore the charging rheostat must

take care of the difference in volts between the battery terminal and the charging mains. The resulting loss in watt-hours is shown for the several sizes of battery in Table IV:

TABLE IV.

No. of cells.	Watt-hours of charge.	Time of charge. Hours.	Volts of mains.	Current of charge.	Watt-hours from Mains.	Watt-hours lost in rheostat.
12	9450	5	115	70.5	40537	31087
24	9000	5	115	35.	20250	11250
32	9560	5	115	26.4	14220	4660
40	9000	5	115	21.2	12180	3180

If a rate of 4 cents per kw-hour is assumed, such rate being one that very generally obtains, the cost of garage charging will be as shown in Tables V and VI:

TABLE V.

No. of cells.	Kw-hours of charge.	Cost.	Kw-hours lost in rheostat.	Cost.	Total cost.
12	9.45	$0.378	31.08	$1.24	$1.618
24	9.00	0.36	11.25	.45	0.81
32	9.56	0.382	4.66	.186	0.568
40	9.00	0.36	3.18	.127	0.485

TABLE VI.

No. of cells.	Vehicle miles.	Cost per mile for kw-hours used.	Cost per mile for kw-hour lost.	Total cost per mile.
12	60.5	$0.625	$2.060	$2.680
24	57.6	0.625	.782	1.407
32	61.25	0.625	.340	.965
40	57.5	0.625	.221	.845

If it is further assumed that the number of vehicles in a garage is made up of an equal number of each size of battery, then the average cost of charging a vehicle is 87 cents at the kw-hour rate taken, when as a matter of fact, the 12-cell battery has cost nearly twice this amount, and the 40-cell battery not quite one-half this amount.

Assuming also that the several batteries will each stand a complete charge and discharge 140 times, after which the positive plates must be renewed, and that such renewal is a part of the total cost of operation; in other words, that the battery is treated as "slow fuel," then the total mileage obtained will be as follows:

12 cells 60.5 x 140 = 8500 miles.
24 " 57.6 x 140 = 8000 "
32 " 61.25 x 140 = 8600 "
40 " 57.5 x 140 = 8000 "

The average catalogued cost of positive plates and assembling for the several sizes of batteries would make the total renewal charge as shown in Table VII:

TABLE VII.

No. cells.	Cost of plates.	Cost of assembling.	Total cost.
12	$82.50	$10.50	$93.00
24	80.50	17.25	97.75
32	86.00	23.00	109.00
40	80.50	28.80	109.30

Reducing the foregoing tables to cost per mile for renewals, the result shown in Table VIII is obtained:

TABLE VIII.

No cells.	Total miles.	Total cost.	Cost per mile.
12	8500	$93.00	1.092 cents
24	8000	97.75	1.22 "
32	8600	109.00	1.27 "
40	8000	109.30	1.37 "

The total cost per mile for electricity and renewals is shown in Table IX:

TABLE IX.

No. cells.	Cost for energy. per mile, cents.	Cost for renewals. per mile, cents.	Total cost, cents.
12	2.680	1.092	3.772
24	1.407	1.220	2.627
32	0.965	1.270	2.235
40	0.845	1.370	2.215

The total cost for the year or for total miles taken as the life of the positive plates is finally shown in Table X:

TABLE X.

Cells.	Cost for energy used.	Cost for energy lost. in rheostat.	Cost for renewals.	Total cost.
12	$53.12	$175.00	$93.00	$321.12
24	50.00	62.56	97.75	210.31
32	53.70	29.20	109.00	191.90
40	50.00	17.60	109.30	176.90

It is seen therefore that under the present conditions of charging vehicle batteries at a garage where a fixed charge or flat rate obtains, the owner of the vehicle equipped with a large number of cells is paying for an unfair proportion of the energy lost in the charging rheostat. This flat rate usually covers charging, washing, ordinary small repairs and delivery of vehicle at residence, and it may be safely stated that no item of this charge is the same for any two of the vehicles, and it is therefore every way unfair. It is particularly unfair in the matter of charging the storage battery; one owner may use his total charge every day, while another would not consume a complete charge in two days or more. The proper manner of determining the cost of charging is with a watt-hour meter, which measures the energy given the battery as taken from the mains, and which, of course, includes the energy lost in the charging rheostat. In this way, each owner pays for the energy he actually consumes, and not for energy based on a guess at the average taken by a number of vehicles. It further determines whether or not the battery is fully charged. The decrease in mileage, frequently noticed, is not necessarily due to decreased battery efficiency, but is often the result of improper and therefore insufficient charge. If, however, a flat rate must be used, it should be worked out for each size battery for the kw-hours taken from the mains, and are, for the several illustrations used, as follows:

TABLE XI.

No. cells.	Flat rate at 4c. per kw-hour, including loss in rheostat.	Kw-hours actually taken by cells.	Equivalent flat rate per kw-hour.
12	$1.618	9.45	17 cents.
24	.81	9.00	8½ "
32	.568	9.56	6 "
40	.485	9.00	5½ "

If we take the two extreme cases as a further illustration affecting the selection of the size of a vehicle battery, we have for the small size a total cost for approximately 8,000 miles or one year's operation $321.12, as against $176.90, for the large size. Where the garage charge is the usual one of $25 per month, or $300 per year, it is seen that the owner of the 12-cell vehicle is apparently getting $21.12 in energy above the total price paid by him for the entire service; while the owner of the 40-cell vehicle is paying $120.10 above his energy cost. The total cost per mile for the small battery is 3.772 cents, and 2.215 cents for the larger size. The rate per kw-hour for energy, based upon 4 cents at the mains, is 17 cents per kw-hour at the terminals of the small number of cells, and 5½ cents per kw-hour at the terminals of the larger battery. Considerations of economy in operation would indicate the use of a battery having a voltage as near the voltage of the charging mains as practicable.

The Single-Phase Induction Motor.—II.

By Alfred Still.

VECTOR DIAGRAMS OF THE SINGLE-PHASE INDUCTION MOTOR.

THE vector diagram of Fig. 6 has been drawn on the assumption that all of the magnetism enclosed by the primary winding passes through the secondary, i. e., that there is no leakage magnetism. We shall also, for the present, neglect the resistance of the primary windings, and the losses in the iron forming the magnetic circuit.

Here the diagram referring to a perfect transformer will be useful for the purpose of comparison. We have merely to consider the stator coil as the primary winding of an ordinary transformer, and the rotor conductors in mechanical line therewith as the secondary winding, through which the whole of the primary flux is supposed to pass. A transforming ratio of one to one is again assumed, which means that a current of one ampere in the primary coil will produce exactly the same magnetizing effect as a current of one ampere in the rotor secondary.

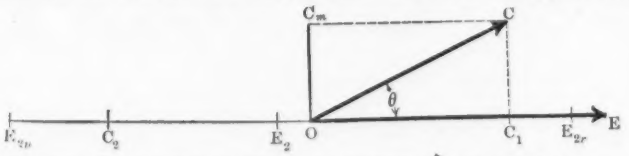


FIG. 6.—SIMPLE DIAGRAM OF SINGLE-PHASE MOTOR.

The vector, $O\,C_m$, in Fig. 6, has been drawn to represent the magnetizing current in the primary circuit; then $O\,E_{2p}$—the secondary induced e.m.f.—must be drawn 90° behind $O\,C_m$ (to rep-

resent the lag of ¼ period), and $O\,E$—the primary impressed potential difference—exactly 180° in advance of the secondary pressure, in order that it may balance the induced pressure in the primary circuit (which is also $O\,E_{2p}$). Imagine the rotor to be revolving at something below synchronous speed, then the rotational e.m.f. (E_{2r}) will be *less* than E_{2p}; and, since this rotational e.m.f. is opposite in phase to E_{2p}, its vector ($O\,E_{2r}$) must be drawn in the same phase as the primary e.m.f., but somewhat less in length. This leaves $O\,E_2$ as the *resultant* e.m.f. in the secondary, or rotor, circuit (the point E_2 being obtained by making $E_{2p}\,E_2$ equal to $O\,E_{2r}$), and if R_2 be the equivalent resistance of the rotor winding, we have merely to divide E_2 by R_2 in order to obtain the value of the rotor current, C_2, the vector of which ($O\,C_2$) must be drawn in phase with the resultant e.m.f., E_2, to which it owes its existence.

An inspection of the diagram of Fig. 6 leads to the following deductions:

(1) The power put into the motor is given by the product of the vectors $O\,C$ and $O\,E$ (obtained by multiplying together the numerical value of $O\,E$ and the numerical value of $O\,C_1$—this last quantity being the projection of $O\,C$ upon $O\,E$).

(2) The power lost in the rotor windings—neglecting any copper loss due to the magnetizing current producing the cross field—is $O\,C_2 \times O\,E_2$.

(3) The power transmitted to the shaft is $O\,C_2 \times E_{2p}\,E_2$ (being the product of armature current and back e.m.f. of rotation).

Let us denote this last quantity—the useful output—by the letter P. We may write:

$$P = O\,C_2 \times E_{2p}\,E_2$$
$$= (\text{the rotor current}) \times (\text{the back e.m.f. of rotation})$$
$$= C_2 \times E_{2r}. \qquad (1)$$

But we can also write:

$$P \propto \text{torque} \times \text{speed}, \qquad (2)$$

and, by equating these two expressions for the rotor output, we shall see how the *speed* of the motor may be read from the vector diagram of Fig. 6.

In the first place, it should be noted that the *torque* is proportional to the rotor current and to the strength of the cross field, or

$$\text{Torque} \propto C_2 \times N_r, \qquad (3)$$

but, as N_r is not represented by a vector in the diagram we must express this quantity in other terms.

The amount of the cross field is directly proportional to the back e.m.f. induced by it, and therefore to the e.m.f. of rotation in the main field,* which again is directly proportional to the *main field*, N_a, and to the *speed*, or rate of cutting through this field; hence,

$$N_r \propto N_a \times S,$$

where S stands for the speed of the rotor. But N_a is directly proportional to the e.m.f. that is induced in the coil *b*, namely, E_{2p} (for the frequency can be considered constant), thus

$$N_r \propto E_{2p} \times S.$$

Substituting in (3) we get:

$$\text{Torque} \propto C_2 \times E_{2p} \times S,$$

which enables us to write equation (2) in the form

$$P \propto C_2 \times E_{2p} \times S^2.$$

If, now, in place of P we put its equivalent, as given by equation (1) we obtain, after simplifying, the expression:

$$S^2 \propto \frac{E_{2r}}{E_{2p}},$$

from which it is seen that, if we divide the rotational e.m.f. (represented by the length $E_{2p}\,E_2$ in Fig. 6) by the pulsational, or induced e.m.f. (represented by the length $O\,E_{2p}$) we obtain a number which is proportional to the square of the rotor speed.

It is convenient to regard S, not as the actual speed expressed in revolutions per minute, but as a percentage of the maximum possible speed, i. e., the speed of synchronism, or the periodicity of the primary supply; then

$$S^2 = \frac{E_{2r}}{E_{2p}},$$

which gives to S the value 1 (or synchronous speed) when $E_{2r} = E_{2p}$, and the value 0 (rotor at rest) when there is no rotational back e.m.f.

Another important point to observe in connection with Fig. 6 is that *if there were no magnetic leakage*, the momentary overload capacity of the motor would be practically unlimited; because, if we neglect mechanical considerations and the heating of the windings, the current C_2 could increase to an enormous extent without any considerable reduction in the strength of the cross field; it is merely a question of rotor resistance. We shall now see how, in a practical machine, having appreciable magnetic leakage, the output is limited by other considerations than rotor resistance.

Vector Diagram Taking Magnetic Leakage into Account.—In all commercial transformers—but more especially in a transformer such as the induction motor, with primary and secondary coils on different portions of the magnetic circuit, separated by an air-gap—there is a certain amount of magnetic leakage; and, in order to simplify the diagrams we shall look upon this leakage as consisting solely of a number of "magnetic lines" which—al-

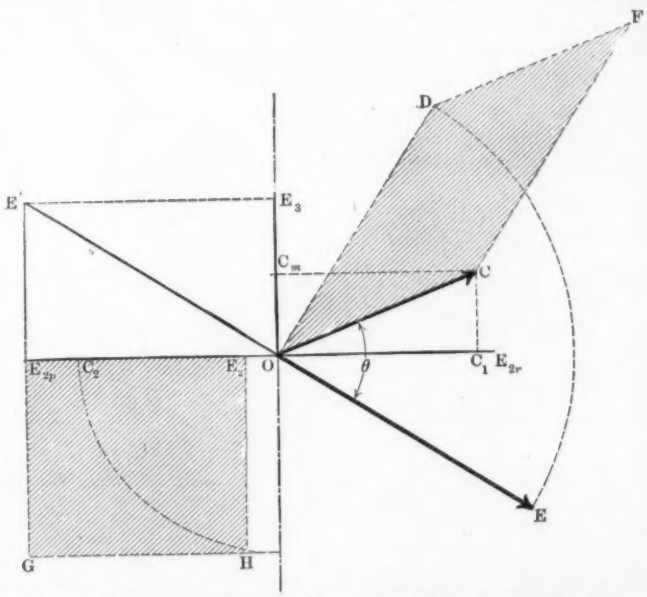


FIG. 7.—DIAGRAM TAKING MAGNETIC LEAKAGE INTO ACCOUNT.

though created by the magnetizing current in the primary circuit—are closed upon themselves through *leakage* paths, and do not thread their way through the secondary circuit. The total magnetic flux which produces the back e.m.f. in the primary or stator winding must, therefore, be considered as made up of two components: (1) The magnetic flux, which passes through the secondary or rotor circuits, and (2) the leakage flux, which, although it induces a back e.m.f. in the primary circuit, cannot be helpful in generating a secondary e.m.f., since it does not enter the rotor. This leakage flux is due to the magnetizing force of the rotor currents which, by opposing an exactly equal magnetizing force in the primary circuit, leads to magnetic dispersion across the pole faces in the air-gap, and along sundry paths, approximately at right angles to the direction of the main flux passing through the rotor.

The diagram of Fig. 7 has been drawn so as to take this leakage flux into account. Here C_2 is the rotor current as before, while C_m and C_1 stand respectively for the magnetizing and "work" components of the total primary current, C, exactly as in Fig. 6.

The secondary or induced e.m.f. in the rotor (E_{2p}) is due to that useful portion of the total flux which threads its way through the rotor circuits; but this no longer represents the total back e.m.f. in the *primary* circuit, because the component, $O\,C_1$, of the primary current will create a leakage magnetic field (in phase with $O\,C_1$), which, in its turn, will give rise to an induced e.m.f.,

* The cross magnetizing current is supposed to be so small and the rotor resistance so low that the resistance drop due to the cross magnetizing current may be neglected.

$O E_3$, in the primary coils, exactly ¼ period (or 90°) behind $O C_1$. The *total* back e.m.f. in the primary circuit will, therefore, be $O E'$, and—since we are still neglecting the ohmic drop in the stator windings—the primary impressed potential difference, to satisfy the assumed conditions as regards secondary current and induced pressures, must be $O E$, drawn exactly equal, but opposite to $O E'$. The power factor of the primary circuit will be $\cos \theta$, where θ is the angle between the vectors, $O C$ and $O E$; and $O E_3$ will be the ohmic drop in the rotor circuit (equal to $C_2 R_2$, where R_2 stands for the equivalent resistance of the rotor conductors). This gives us $O E_{2r}$ (equal to $O E_{2p} - O E_3$) as the back e.m.f. of rotation due to the rotor conductors cutting through the cross field.

The areas of the shaded parallelograms are respectively proportional to the power put in at the stator terminals, and the power transmitted to the shaft by the revolving rotor. They are readily constructed by moving any one of the two vectors, whose product is required, through an angle of 90°.

Although the diagram of Fig. 7 is sufficiently accurate for our purpose, the complete diagram for a single-phase induction motor has been drawn in Fig. 8, mainly with the object of showing that no serious difficulties need be experienced when taking into account the hysteresis and eddy-current losses in the iron, and the copper loss in the primary winding, all of which have, up to the present, been considered negligible. The construction of this amended diagram is similar to that of Fig. 7, and no explanation is required; but note that the magnetizing current component, $O C_m$, is no longer a *wattless current;* it is made up of the wattless component, $O C_o$, and the power component, $C_o C_m$; and this

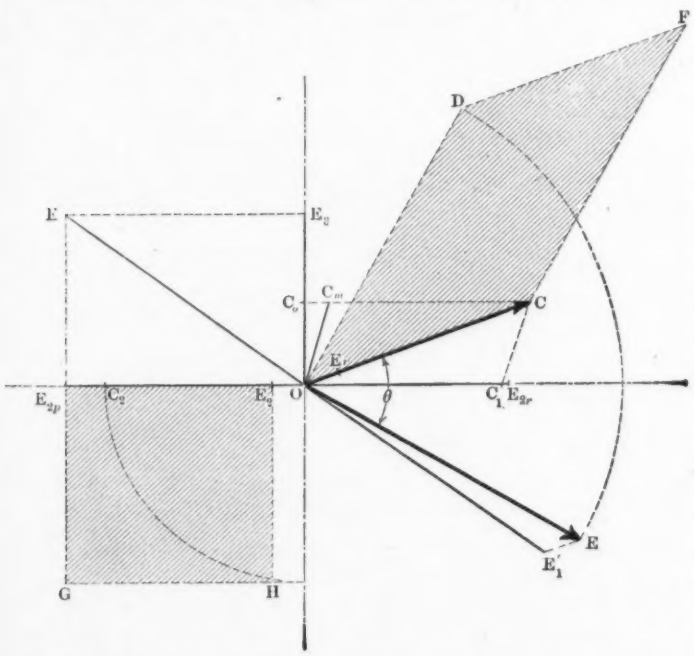


FIG. 8.—COMPLETE VECTOR DIAGRAM FOR A SINGLE-PHASE INDUCTION MOTOR.

latter quantity, when multiplied by the numerical value of $O E_{2p}$, will give the watts lost in hysteresis and eddy currents. Again, $O E'$ is no longer the primary impressed potential difference; there is a potential drop, $O E_r$, in phase with $O C$, and equal to $C \times R$ (where R is the resistance of the primary winding), and the required pressure across the primary terminals will, therefore, be $O E$, obtained by compounding $O E'$ and $O E_r$. Note also that the leakage e.m.f. for the same rotor current is slightly greater than before, being due to the total "work" component ($C_o C$) of the primary current. It should not be necessary to draw attention to the fact of the difference between the areas of the two shaded parallelograms being greater than in Fig. 7, because, in the latter diagram, the only loss taken into account was the power wasted in heating the rotor conductors; while Fig. 8 includes all the losses, with the exception of windage and bearing friction, and also any eddy current and hysteresis losses due to that component of the total magnetic flux in the stator which does not thread its way through the rotor. If these last-mentioned losses are to be taken into account, the effect will be a slight reduction in the angle θ and a corresponding increase in the area of the parallelogram, $O D F C$.

OVERLOAD CAPACITY OF COMMERCIAL INDUCTION MOTORS.

With the aid of the vector diagrams in Figs. 7 and 8, it is easy to understand why, in a motor with appreciable magnetic leakage, a point is reached beyond which any further increase of the load on the shaft cannot be met by an increased turning moment on

FIG. 9.—TORQUE-CURRENT CHARACTERISTICS OF SINGLE-PHASE INDUCTION MOTOR.

the part of the rotor, with the result that the machine breaks out of step and comes to rest.

It has been explained how the shaded area, $E_{2p} E_3 H G$, in Figs. 7 and 8 represents the power transmitted to the shaft by the revolving rotor. With comparatively small values of the rotor current, C_2, the product $C_2 \times (E_2 E_{2p})$ will *increase* with the increase of the rotor current; it should be noted also that every increase of C_2 implies a greater leakage field, and, therefore, a decrease in the amount of the useful flux through the rotor. Assuming the total primary e.m.f., E, to be maintained constant, any increase in C_2 leads to a reduction in the back e.m.f. of rotation, and a point is reached beyond which any further increase of the rotor current causes so great a reduction in the rotor field that the shaded area, $E_{2p} E_2 H G$, instead of increasing in value, will begin to *decrease*. This means that the maximum possible output of the motor has been reached, and any additional demand for power will simply result in the rotor coming to rest. By constructing the diagram of Fig. 7 for larger values of C_2 it will readily be seen that the increase of $O E_3$ and the corresponding reduction of $O E_{2p}$ will soon cause these two vectors to be of equal value; and since this condition gives the greatest area for the rectangle, $E' E_3 O E_{2p}$, it will also approximately correspond with the limiting overload condition, on account of the proportionality between $O E_3$ and $O C_2$ (or $E_2 H$).

In practice the overload capacity of single-phase induction motors has, until recently, been small; but improvements in design have resulted in motors being put on the market with overload capacities varying from 50 per cent to 150 per cent of the normal full load.

RELATION BETWEEN TORQUE AND ROTOR CURRENT, AS AFFECTED BY THE LEAKAGE FIELD.

In order to indicate clearly how magnetic leakage is responsible for a great falling off in the torque as the rotor current is increased beyond a certain value, the curves in Fig. 9 have been plotted from measurements taken on Fig. 7, this vector diagram having been reconstructed for various values of the rotor current.

It has already been stated that the torque depends upon the product of the rotor current and the amount of the cross flux, i. e.,

$$\text{Torque} \propto C_2 \times N_r, \qquad (3)$$

but as N_r is not represented by a vector in Fig. 7, this quantity must be expressed in other terms. The useful cross flux (N_r) which owes its existence to the rotation of the conductors in the

main field, N_a, is proportional to the product, $E_{2p} \times S$, where S stands for the speed of rotation; hence,

$$N_r \propto E_{2p} \times S.$$

Now, the cross flux can also be expressed in terms of the rotational e.m.f., E_{2r}, and the speed, for clearly

$$E_{2r} \propto N_r \times S,$$

and we have merely to eliminate S from these two equations to obtain the relation

$$N_r^2 \propto E_{2p} \times E_{2r}.$$

Inserting the value thus obtained for the cross flux, N_r, in equation (3), we get

$$\text{Torque} \propto C_2 \times \sqrt{E_{2p} \times E_{2r}}.$$

In plotting the curves of Fig. 9, arbitrary values have been assumed for the rotor resistance, which determines the length

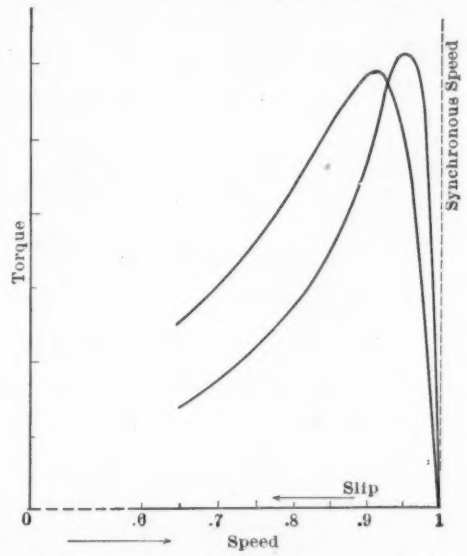


FIG. 10.—SPEED-TORQUE CHARACTERISTICS OF SINGLE-PHASE INDUCTION MOTOR.

$O E_2$ (or $E_{2p} - E_{2r}$) in Fig. 7; the upper curve has been drawn on the assumption of a rotor resistance such as to make the ohmic drop ($O E_2$) equal to one tenth of the leakage drop ($O E_3$), while the lower curve has been drawn for a rotor resistance exactly double the above amount, or such as to make $O E_2$ one-fifth of $O E_3$.

In either case it will be seen how the torque exerted by the rotor rises with the increase of the current until a maximum is reached, after which a further increase of current leads to a rapid falling off in the turning effort, owing to the great reduction of the useful motor field. When the external load is such that the rotor is exerting its maximum torque it is clear that any further increase in the load must result in the pulling up of the motor. It is of course understood that the total primary flux (or the e.m.f. vector, $O E$, in Fig. 7) is supposed to remain constant for all values of the rotor current.

RELATION OF TORQUE TO SPEED.

The curves in F.g. 10—which have been plotted from measurements taken on the same vector diagram (Fig. 7)—show the relation between torque and speed (or "slip") for the same two values of the rotor resistance as were selected for the purpose of drawing the curves in Fig. 9. The horizontal distances measured from left to right indicate the speed of revolution, expressed as a percentage of the maximum or synchronous speed: it is calculated from the formula

$$S = \sqrt{\frac{E_{2r}}{E_{2p}}},$$

which was obtained when discussing the vector diagram of Fig. 6. It should be noted that, under running conditions, i. e., with speeds closely approximating to that of synchronism, the torque is practically proportional to the "slip": the two curves (Fig. 10) also clearly show how the resistance of the rotor winding determines the speed corresponding with a given torque. The taller of the two curves shows the relation between torque and speed for a comparatively small rotor resistance (the smaller of the two values assumed for the calculation of the curves in Fig. 9), while the second curve shows the effect of doubling the resistance of the rotor windings. As a close approximation to actual working conditions, it may be said that near synchronism the "slip" corresponding to a given torque is directly proportional to the resistance of the rotor windings.

CURVES OF EFFICIENCY, POWER FACTOR, ETC., DEDUCED FROM VECTOR DIAGRAM.

Referring to the complete vector diagram, Fig. 8—which takes into account the most important losses in the machine, and may be considered sufficiently accurate for most purposes—let us plot curves of efficiency, speed and power factor in relation to the output of the motor, as an illustration of the utility of such a vector diagram, if not as a test of its correctness. In order that the diagram may be drawn to scale for various values of the rotor current (C_2), certain data must be assumed.

In the first place, the transformer ratio between primary and secondary windings is, as in all previous cases, supposed to be 1:1; and the following particulars and relations have also been assumed:

Full load output = about 26 hp.
Full load efficiency = .85.
Full load power factor = .83.
Primary volts = about 200.

From these particulars the full load current can be calculated, and it will be found to be in the neighborhood of 120 amp. The current, when running light, would be about one-third of this, and we may write:

No load primary current ($O C_m$ in Fig. 8) = 40 *amp.*

Now, this is not a pure magnetizing or wattless current; it must have a component in phase with the main component of the primary current, to cover the losses by hysteresis, eddy currents,

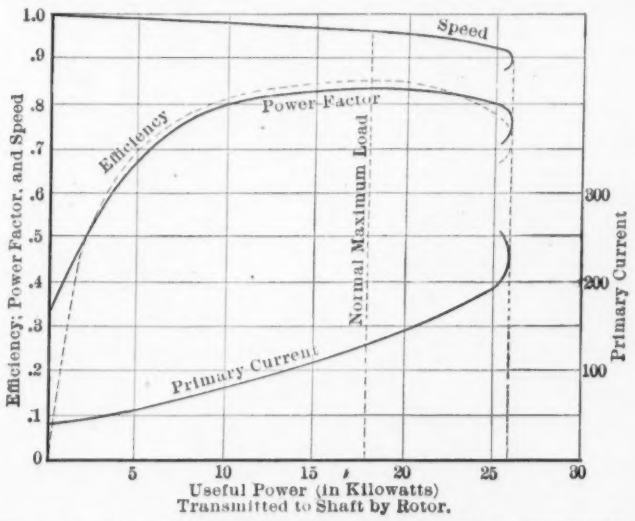


FIG. 11.—LOAD CHARACTERISTICS OF SINGLE-PHASE INDUCTION MOTOR.

windage and friction; this might be fully one-quarter of the total no load current, or:

"Work" component of no load primary current ($C_0 C_m$ in Fig. 8) = 12 *amp.*

There still remain three conditions to be determined before the diagram can be drawn to scale; these are the respective effects of primary and secondary ohmic resistance, and magnetic leakage. These pressure losses can all be expressed in terms of the current vectors, and it is assumed that

The leakage volts ($O E_3$) = .56 C_2.
The voltage drop in rotor resistance ($O E_2$) = .14 C_2.
The voltage drop in stator resistance ($E_1' E$) = .105 C.

For the purpose of plotting the curves in Fig. 11, the diagram of Fig. 8 has been redrawn from the foregoing data for various values of the rotor current, C_2. The *useful power transmitted to*

the shaft by rotor is simply the area of the shaded rectangle, $E_s H G E_{zp}$, while the *primary current* is the length $O C$. The other three quantities plotted are:

$$\textit{Speed, expressed with synchronism as unity} = \sqrt{\frac{E_{zr}}{E_{zp}}}$$

Efficiency = the ratio of the areas of the two shaded parallelograms or,

$$\frac{E_{zr} \times C_z}{E \times C \cos\theta}.$$

Power factor $= \cos\theta$.

If the curves in Fig. 11 are compared with the results of actual tests on commercial machines, it will be seen that they correctly indicate the manner in which the various quantities considered depend upon the load. It will also be observed that a machine of such a design as to fulfil the conditions regarding leakage drop, etc., that have been assumed in working out this example, would pull up on an overload exceeding the normal full load by about 50 per cent.

CIRCLE DIAGRAMS.

Although the vector diagrams of Figs. 7 and 8 are of considerable practical value, they are mainly of use for explaining the theory of the single-phase induction motor; moreover, these diagrams are drawn for an assumed value of secondary current ($O C_z$) from which the magnitudes and phase relations of the other vector quantities are deduced.

Instead of working backwards in this manner, from resulting current to impressed primary e.m.f., it would clearly be of advantage to start from a known primary voltage and construct a diagram showing the phase relations between the various currents and this impressed e.m.f. for any value of the primary current. The circle diagram fulfils these requirements, and Fig. 12 will serve to show how it may be deduced from Fig. 7.

In the first place it should be noted that the various pressure vectors, $O E$, $O E_{zp}$ and $O E_s$, and the three current vectors, $O C$, $O C_m$ and $C C_m$ (this last being equal in magnitude and phase to the rotor current, $O C_z$) are drawn exactly as in Fig. 7, and represent the same alternating quantities.

Describe the semicircle, $E N O$, on $O E$ as a diameter; produce

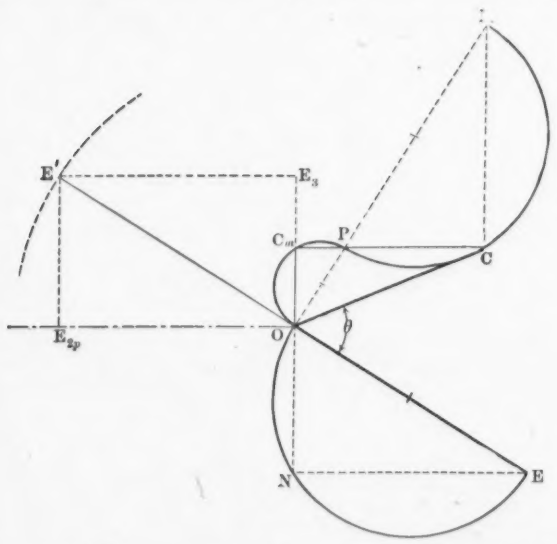


FIG. 12.—METHOD OF CONSTRUCTING THE CIRCLE DIAGRAM.

$E_s O$ to N and join $N E$. The two dotted lines, $O N$ and $N E$, are respectively equal to the two pressure components, $O E_s$ and $O E_{zp}$, and moreover, since the angle, $E N O$, is inscribed in a semicircle, it will always be a right angle, even if the point N be supposed to move on the circumference of the circle. It follows that the lines $O N$ and $N E$ will always represent, in place and magnitude, the useful and leakage components of the total back e.m.f., if we imagine the vector $O E$ to remain stationary, while the point N may occupy any position on the semicircle.

Now draw $O M$ at right angles to $O E$; it will cut the line $C_m C$ at P. On $O P$ as a diameter describe the semicircle, $O C_m P$ (it will pass through the point C_m because $O C_m P$ is a right angle). From a center taken on the line $O M$, and with a suitable radius, describe the semicircle $P C M$, passing through the point C, and join $C M$. In this manner three similar right-angled triangles, $E N O$, $O C_m P$ and $M C P$, have been formed, the lengths of the sides being such as to fulfil the condition

$$\frac{E N}{N O} = \frac{O C_m}{C_m P} = \frac{M C}{C P}.$$

Note also that, if the point C be supposed to move on the semi-

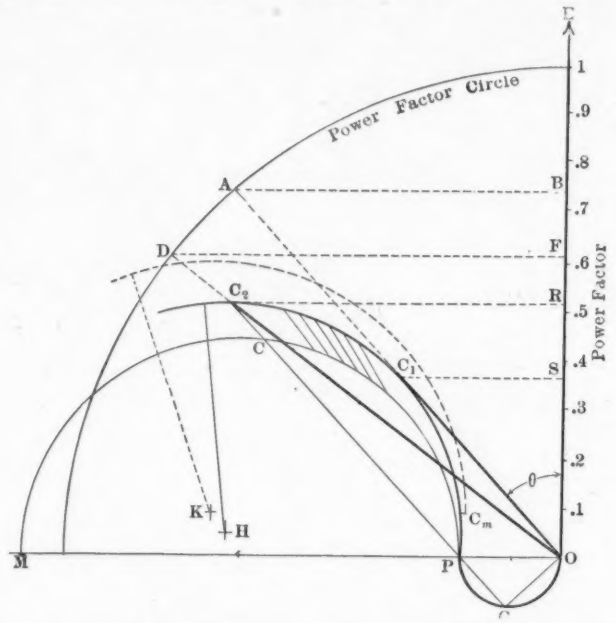


FIG. 13.—CIRCLE DIAGRAM OF SINGLE-PHASE INDUCTION MOTOR.

circle, $P C M$, the points C_m and N will move similarly on the semicircles, $O C_m P$ and $E N O$; but without interfering with the proportionality between the lengths of the sides, since the triangles will still remain right-angled and similar. Referring once more to Fig. 7, there are two important relations which must always hold good: in the first place, the e.m.f. leakage component, E_s, must be proportional to the rotor current, C_z, and, in the second place, if there is no appreciable saturation of the iron cores, the secondary induced e.m.f. (E_{zp}) must be proportional to the amount of the magnetizing current ($O C_m$), which produces the magnetic flux through the rotor. It follows that the relations: length $O C_m$, proportional to length $O E_{zp}$; and length $O C_z$ proportional to length $O E_s$, must hold good in Fig. 12 as in Fig. 7. But in Fig. 12 these conditions may be expressed as: $O C_m$ to be proportional to $E N$; and $C_m C$ to be proportional to $N O$. That the first of these conditions is satisfied is clear from the similarity of the two triangles, $O C_m P$ and $E N O$, in Fig 12; and, as regards the length $C_m C$, this is made up of two component parts, $C_m P$ and $P C$, each one of which varies in direct proportion to the length $N O$; it therefore follows that $C_m C$ is also proportional to $N O$, which proves that even if the points C, C_m and N be supposed to move on their respective semicircles, the diagram of Fig. 12 will always correctly represent the various current and e.m.f. vectors.

To use such a diagram we have merely to consider the vector, $O E$, representing the impressed stator e.m.f. to be fixed, both as regards magnitude and position; if we then join any point, such as C, lying on the semicircle, $P C M$, to the point O, we have $O C$ as the magnitude of the primary current, and the cosine of the angle $C O E$ as the power factor. Moreover, by drawing $C C_m$ through P, and joining $C_m O$, we have $O C_m$ as the magnetizing component of the primary current, and $C_m C$ as the "work" or "power" component, these vectors being correct, not only in respect to length, but also in their phase relations relatively to the impressed volts, $O E$, and the total primary current, $O C$. The vector, $C C_m$, stands for the secondary or rotor current on the assumption of a 1:1 transforming ratio.

In Fig. 13 the circle diagram has been redrawn, with the pressure vector $O E$ in a vertical direction. This brings $O M$ horizontal;

but the semicircles, $M C P$ and $P C_0 O$, may be considered as being exact repetitions of the corresponding circles in Fig. 12, the only difference being that the point C_m in Fig. 12 has been lettered C_0 in Fig. 13. In the diagram of Fig. 12, which was deduced from Fig. 7, the iron losses and primary resistance were neglected; but since we may assume the hysteresis and eddy-current losses to be constant under ordinary conditions of working, it is only necessary to add a constant length ($C_0 C_m$ in Fig. 8) to the rotor current vector, in order to make this correction to the circle diagram. This has been done in Fig. 13, by drawing a number of lines radiating from the point P, and plotting the curve $C_m C_1 C_2$, which fulfils the condition of any chord, such as $P C_2$, being greater than $P C$ by the amount $C C_2$ or $P C_m$, corresponding to the "power" component of the magnetizing current ($C_0 C_m$ in Fig. 8). This curve, $C_m C_1 C_2$, will be found to correspond almost exactly with the arc of a circle described from a center, such as H, lying somewhat above the horizontal line, $O M$. This new curve is used in place of the semicircle, $P C M$, and, for any primary current vector, such as $O C_2$, the wattless magnetizing current is $O C_0$, while the "power" component is $C_0 C_2$; the rotor current is $C C_0$ and the power factor $\cos C_2 O E$.

If it is desired to take into account the effects of the primary resistance, the end of the primary current vector, instead of lying on the curve $C_m C_1 C_2$, would lie on a new curve, such as the one indicated by the dotted line, and this will be found to approximate very closely to the arc of a circle, of larger radius than $H C_2$, described from a new center, K. Assuming the stator resistance to be so small as to be negligible, draw the tangent $O A$ to the curve $C_m C_2$; this touches the curve at C_1. It follows that the angle $E O A$ is the smallest possible between the primary e.m.f. and current vectors. $\cos \theta$ is, therefore, the maximum possible power factor.

It is interesting to note how it is the relation between the sizes of the circles $O C_0 P$ and $P C M$ (or $C_m C_1 C_2$ if the iron losses are taken into account) which determines the maximum possible power factor obtainable with a given design of motor. To obtain a high power factor it is not only necessary to keep the air-gap small, thus reducing the amount of the magnetizing current, but due attention must also be paid to the shape of the slots, the disposition of the windings, etc., in order that the leakage flux, due to a given value of secondary current, may be as small as possible. A study of Fig. 12 will enable the reader to trace the connection between the sizes of the two circles referred to, and these causes which influence the power factor.

If, in Fig. 13, we drop perpendiculars such as $C_1 S$ and $C_2 R$ from the ends of the primary current vectors on to $O E$, the *power* supplied to the motor will be represented, to a certain scale, by the distances $O S$, $O R$, etc. Thus the power corresponding to the condition of maximum power factor will be $O S$, while the maximum possible input will be $O R$, the line $C_2 R$ being the horizontal tangent to the curve $C_m C_1 C_2$.

Again, as regards the power factor, instead of calculating this from the measured value of the angle between e.m.f. and current vectors, a circle may be described from the center, O, of any convenient radius, $O A$, which shall be considered unity. Then, if any primary current vector be produced until it meets this circle, and the point of intersection projected on to $O E$, the length of the projected line is a direct measure of the power factor. Thus, for the two special conditions of maximum power factor and maximum possible input, the power factors are $O B$ and $O F$, respectively, corresponding to the values .74 and .61.

Many other additions can be made to the circle diagram, by means of which other variable quantities can be expressed graphically, and measured by merely scaling the length of a straight line; but such additions tend to complicate the appearance of the diagram and so detract from its value as a simple and perfect means of showing, almost at a glance, what will be the behavior of a given design of motor. It is frequently more convenient to seek the more important quantities from the diagram and use the slide rule for obtaining those other quantities which may not be represented by straight lines. The important point to note is that the circle diagram, although very simple in construction, yet contains all the information of importance relating to the behavior of the motor under actual working conditions.

Municipalities Versus Electric Signs.

By William Goltz.

It is a curious fact that in this age of rapid commercial progress, and in a country where business interests are paramount, there may be found municipalities—large and small—where the authorities for reasons known but to themselves, object to the installation of overhanging electric signs. Some of them have ordinances prohibiting the installation of *all* overhanging signs; others require special council permits in each instance, thus providing a source of petty graft; still others permit signs to be operated which, without permit, have been installed over night. By electric signs I mean those in which incandescent lamps form the outline of the letters and not the well-known huge billboards with the lamps concealed behind reflectors, which latter at best can only be called eye-sores. If one asks why the installation of such signs should be prohibited it is usually hard to get an answer, but now and then one or the other objection is cited.

It is claimed, first, that such signs might eventually interfere with and hamper the movements of the fire department. On seriously considering this objection, it seems of little value as it is practically inconceivable how an overhanging electric sign can prevent the firemen from getting hose or water to any part of a building, or from moving their apparatus to any desirable place. It does not obstruct the sidewalk or the doors, or the street, as is done by electric light or telephone wires, merchandise piles on the sidewalk, and delivery wagons lined up on the curb. Yet all of this is usually tolerated because the people do not seriously object, and for business reasons are willing to put up with it.

Others claim that a sign might be blown down and injure some one. Experience has shown that electric signs can be installed in such a manner that they cannot be blown down. The electric sign ordinance of the city of Chicago prescribes a method of hanging so substantial that a sign put up in accordance therewith will and does safely resist all wind storms.

This, then, seems to dispose of the objections which may be raised to the installation of overhanging signs. On the other hand, some rather strong arguments may be advanced showing why a municipality should, on the contrary, encourage their use.

It is a well-known fact that brilliant light attracts and induces street travel. People will not use dark streets unless forced to, and merchants located therein will not use display lighting because there is no one to see their windows. Taking into consideration that none of our municipalities, for financial or other reasons, have ever been able to light any streets brilliantly, it would seem that they would be anxious to avail themselves of an opportunity offered to accomplish this feat at no expense to them. Electric signs and electric display lighting furnish an illumination far exceeding in quality and brilliancy that produced by any other known method of street lighting. The real progressive merchant knowing full well the tremendous advertising power of the electric sign will, as soon as all obstacles in the way of getting a permit are removed, select this method which for a certainty will bring him the greatest return for each dollar expended. Once the start is made and a number of signs have been installed, the public will appear on the street and the merchant, in order to display his merchandise, will have to light up his show windows. The more signs there are, the more display lighting you will see, and the better they are distributed in various parts of the city the more money will be saved on the municipal street lighting account. That a city presenting a bright and lively appearance at night will soon be known as progressive and will receive the preference from merchants and manufacturers seeking location, goes without saying.

The results to be looked for from the installation of electric signs being, therefore, advantageous for any city, it should be the duty of the authorities to regulate this feature so as to accomplish the desired end in a safe and practical manner. An electric sign ordinance, while insisting upon the signs being lighted for a certain number of hours each week, and that the signs should give a sufficient amount of light as compared with the size, should be exceedingly liberal as regards facilities for obtaining permits and as regards dimensions and locations. Signs should be allowed to extend as far as the curb, if supported at

one end, and to go clear across the street if supported from both ends. Nothing need be stipulated about the appearance of a sign, as the merchants will take care of that themselves by trying to outdo each other in the laudable purpose of having the best sign on the street. That properly drawn sign ordinances will provide regulation making the use of electric signs safe and desirable has already been shown by experience in some of our largest cities. Such an ordinance should contain, among others, the following provisions:

(1) Application for permit, electrical inspection and inspection as to safety of installation. (Inspection should be made upon installation and annually thereafter.)

(2) Obligation on the part of the owners to operate signs on week days from dusk to 11.30 p.m.

(3) Rules establishing minimum number of lamps in a sign as compared with its dimensions.

(4) Dimensions of signs.

(5) Charges for inspection.

Owing to lack of space it is impossible to give here a model ordinance which with slight modifications might be used everywhere, but if the features mentioned are elaborated upon to suit local conditions it is safe to say that after an ordinance based thereon has been in effect for sometime the results will be a cause of surprise to the city authorities who will ask in wonderment "why did we not think of this before?"

New Telephone Patents.

ADJUSTABLE PHANTOM.

H. O. Rugh, of Chicago, has found that when an attempt is made to phantom a single circuit, the phantom working over ground, it is difficult to prevent interference. Because of this he arranges an adjustable rheostat across the line and attaches his phantom to the arm so that as this arm is displaced from the middle joint it cuts resistance out toward one limb of the line and in toward the other to balance for inequalities.

SELECTOR FOR AUTOMATIC SYSTEM.

C. E. Scribner has obtained a patent for a selector for a small automatic system which he has assigned to the Western Electric Company. A pointer traveling over a dial may be set to the proper number and then a level is oscillated manually until the pointer travels back to zero and stays there. Means must be provided for breaking the circuit properly no matter what the speed of vibration of the lever, and furthermore a few extra strokes of the lever must be of no effect.

A trigger pawl controls the contact breaker and this pawl trips off the breaker to permit it to return under spring power Although the contacts are separate throughout a large part of the motion of the lever, the circuit opens only at the trip as the pawl and stop form an auxiliary pair of contacts in shunt to the breaker. The lever carries another pawl which steps the pointer back to zero. Its action becomes of no effect when the zero point is reached, as a tooth is missing from the ratchet at that point. Incidentally as the ratchet reaches zero it closes an auxiliary shunt about the contact breaker so that there can be no more breaks in the circuit.

TRANSMITTER ARM.

A pressed steel transmitter arm has been patented by J. A. Loff, of Chicago, the patent being assigned to the Kellogg Switchboard & Supply Company. The arm, which is for wall sets, is built up of sheet metal punched to the right shape. It has the appearance of the usual arm, except that it carries ears at its outer end to receive the transmitter. The base piece carries a formed lug adapted to slip in the end of the arm. This is composed of two formed ears arranged to brace each other, and yet each presents an annular surface to its own side of the arm. The clamping bolt passes through the center of the annular ears and since there is no internal support to the thin walls of the arm immediately about the clamping bolt, a yielding springing clamp is formed.

INTERCONNECTING OF LINES.

C. A. Beaver, of Anita, Iowa, has under the title "Telephone System" obtained a patent for connecting grounded and metallic lines together by direct metallic contact. It is difficult to see wherein the invention differs from the practice existing almost from the beginning of telephony.

AUTOMATIC RINGING TRUNK.

While many telephone men have little faith in the automatic system as the ultimate solution of the telephone exchange problem, still almost all feel that the present manual switchboards must be equipped with more and more automatic devices to obtain the best result. All present-day switchboards are provided with all sorts of conveniences not considered at all as necessary for their predecessors. In line with this general trend is a trunking system for common battery systems, which provides automatic ringing of the called subscriber without any special action on the part of the switching operator. This system is the invention jointly of J. G. Wray, H. T. Gardner and W. G. Kinton, of Chicago, and is covered by four patents, all of which have been assigned to the American Telephone & Telegraph Company. The system has been designed for calling circuit working with one-way trunks. The ringing current is normally cut off the plug so that the plugs will not give shocks. In order to apply ringing current the incoming end of the plug must be home in a jack and a distant operator must have picked up the other end of the trunk. Then ringing and direct current are alternately connected by a slow-moving timed commutator. As soon as a response is had, the relays cut off the ringing circuits and lock them off. The circuits provide for through signals for supervision and disconnection. This system is also worked out to provide for four-forty ringing, both with a control push to be operated momentarily by the switching operator to connect up the desired kind of current and for automatic selection of special ringing current. In the latter case selection depends upon a limit relay, which fails on certain jacks because of the high resistance in the circuit.

Another modification provides for operating from toll boards where a special operating system is used, while a fourth provides for an automatic busy test. With this last the switching operator puts up connections irrespective of whether or not lines are busy. The automatic device maintains an open trunk and sends back the busy signal.

SWITCHBOARD CIRCUIT SYSTEM.

W. W. Dean has found difficulty with two-wire systems of the Kellogg Company type, with a relay bridged off each line to ground, from the unbalancing effect of these relays, when two lines are connected together. To overcome this he makes a reversal in the middle of the cord circuit and thus one relay is bridged off each side of the line and thus they balance each other.

CAR TELEPHONE.

As there is considerable danger of shock from a car telephone due to the high-tension lines paralleling its line, efforts are being continually made toward efficient protection. C. E. Scribner has patented an instrument in which the door controls switch plungers which cut the line through to the instrument circuits and control the primary circuit, respectively. Between the automatic line switch and the instruments is a repeating coil, the primary side of which is protected by fuses and carbon plates. Besides this a grounded plate forms the partition between the protector and the instrument case.

CHARGING STORAGE BATTERIES OVER TRUNKS.

T. G. Martin, of Chicago, has patented a circuit arrangement by which branch automatic exchanges may have their storage batteries charged over the trunks from the main exchange. He has assigned his patent to the Automatic Electric Company.

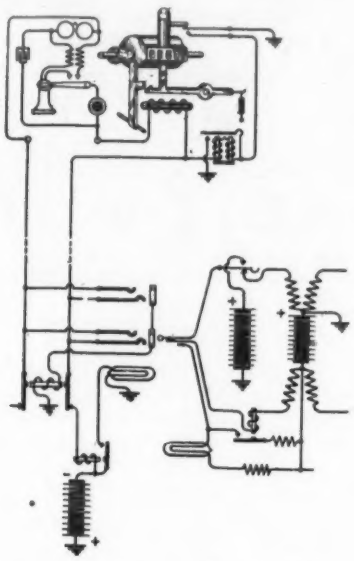
RINGING COMMUTATOR.

Messrs. W. E. Butler and M. L. Lane, of David City, Neb., have jointly patented a motor-driven commutator for supplying ringing current when furnished with direct current of suitable potential. The commutator performs the usual functions.

SUB-STATION COUNTER.

A sub-station message counter has been patented by H. D. Stroud, which is somewhat novel in that in order to make a call

to the exchange one call must be registered. If no connection results due to any cause, normal or abnormal, the operator can credit a call by setting the apparatus so that the next call may be made free of charge, as the next call to the exchange will



STROUD SUB-STATION COUNTER.

not cause a count. In the figure the apparatus is shown diagrammatically. The counter moves bodily with the push button, but only registers when the lever on its shaft is blocked. This lever is blocked by the armature of the relay. If a call fails the operator applies her extra battery and latches up the armature out of line with the lever. The next depression of the push fails to count, but releases the armature.

LINE SIGNAL RESTORER.

As people will inadvertently leave the receiver off the hook, much to the annoyance of the exchange, R. A. Davidson has thought it advisable to provide an apparatus to render this of no effect. The device resembles a self-restoring drop, except that it is reversed in action. If a receiver is off the hook a ring on the line pulls up an armature which latches. This movement opens the telephone circuit and makes the bell effective. The restoration of the hook switch, through the action of the second winding, trips the armature latch to close the talking circuit again.

DISTRIBUTING BOARD.

A patent has been issued to C. E. White, of Chicago, for a distributing frame consisting of a number of vertical angle-irons with flanged bases. On one leg, or, say, the web, one set of terminals is arranged in a row, while on the flange side the other terminals are arranged. At the apex the rings are mounted projecting at 45° to both web and flange. Frank B. Cook has obtained the patent of Mr. White by assignment.

LETTERS TO THE EDITORS.

Storage Batteries for Railway Signal Work.

To the Editors of Electrical World:

SIRS:—In your issue of November 10 appears an article on the "Installation and Maintenance of Storage Batteries," taken from the report of Mr. I. S. Raymer to the Railway Signal Association. The following additional points may be of service to your readers:

The report states that storage cells used in signal work should be examined once a week by making voltage and specific gravity tests, etc. This direction evidently refers to that kind of installation in which storage cells are placed at permanent points on the road and charged over a transmission wire from a central station. This method of operation is the preferred one upon the Eastern roads. In the West, however, there are a very large number of portable storage battery cells in use, which cells have sufficient capacity to operate signals for a period greater than one month. The cells are placed near the signals, after being charged at the power house, and remain in operation for one month, at the end of which time they are returned for charge. In this class of service it is not necessary to make voltage and specific gravity tests of the cells each week, but these observations should be taken at the end of each charge and discharge, and the cells given a general inspection.

With the plan of operation in which the batteries are situated at permanent points and charged over a transmission line, the different cells are likely to be discharged at varying rates and amounts. On charge these cells are thrown in series. Since the cells are unequally discharged, it will naturally arise that some of them will require a longer time for recharging than others. Special care should, therefore, be used on the charge to prevent those cells which have done the least work from becoming overcharged. Where it is practicable the cells which first become charged should be cut out. Where this is not practicable the entire series of cells on charge should be cut out from the charging circuit when that set of cells which has done the greatest amount of work has been charged, and care should be used to prevent prolonging the charge beyond this point. During these frequent charges it is advisable not to charge the cells up to their maximum, but to cut off the charging current when the density of the solution has risen within about three points of the maximum. If these frequent charges occur every day, about once a week the charging current should be prolonged for about one-half or three-quarters of an hour after all of the cells have reached their maximum specific gravity. The effort should be made throughout all this work to charge the minimum necessary amount, with the exception of the weekly overcharge as just stated.

The question of capacity in batteries for railway signal work is of the greatest importance, and in no case should cells be installed of such small size that they will be completely discharged during one cycle of operation. Just what the reserve should be is governed by local conditions, this varying from 100 per cent to 700 per cent, or 800 per cent.

Storage cells for signal work are rapidly superseding primary batteries, and at the present time there are in the neighborhood of 60,000 storage cells in service in railway signal and interlocking work, having an aggregate capacity of 7,500,000 watt-hours. Practically all of these cells have been installed within the past seven or eight years.

PHILADELPHIA, PA. EDWARD L. REYNOLDS.

Price of Tantalum Lamps.

To the Editors of Electrical World:

SIRS:—In your issue for July 14, 1906, in referring to the price of tantalum lamps, Mr. F. W. Willcox states that American manufacturers are offering tantalum lamps to the public at a price of 60 cents each for lots of not less than 500 lamps, and he states that he thinks "proper credit is due to the American manufacturer for thus making a lower price than is quoted abroad on this lamp."

The object of the present letter is to call attention to the fact that while tantalum lamps are listed at 2-9 each, a discount of 20% is readily obtained by anyone in purchasing these lamps, even in comparatively small numbers. This brings the price down to 2-3, or 50 cents per lamp. The price paid in England is thus some 10% lower than the price paid in America, and the American manufacturer has thus evidently not been so successful as would appear from the statement above referred to.

LONDON, ENG. E. G. KENNARD.

The Buffalo and St. Louis Expositions.

To the Editors of Electrical World:

SIRS:—It is evident that the correspondent who wrote the article "Electricity at the Jamestown Exposition" in the November 3d issue of the ELECTRICAL WORLD was very wrongly informed in regard to the electrical engineering personnel at the Buffalo

and St. Louis Expositions. At the Buffalo Exposition, Mr. Henry Rustin was chief of mechanical and electrical department. Mr. Robert H. Moore was Mr. Rustin's assistant. The late Luther Stiernger was consulting electrical engineer, and Mr. Guthrie Gray, also deceased, of Mr. Rustin's department, was his assistant. At the St. Louis Exposition Mr. Henry Rustin was chief of mechanical and electrical department, and Mr. Robert H. Moore was his assistant from November, 1901, to March, 1904, during which time all plans for power, illumination and construction were perfected by these engineers.

Mr. E. B. Ellicott, of Chicago, was acting chief of the department from December, 1903, when Mr. Rustin left to seek his health, until Mr. Rustin resigned in March, 1904, when Mr. Ellicott became chief, and Mr. Dixon took up Mr. Moore's work as assistant. Mr. Ellicott severed his connection with the Exposition in June, 1904. He was succeeded by Mr. Foster, who was chief engineer, who held this position until the close of the Fair. Mr. Dixon was his assistant in charge of electrical maintenance. Mr. Rustin did not die until February, 1906.

St. Louis, Mo. John B. Hayes.

DIGEST OF CURRENT ELECTRICAL LITERATURE

Dynamos, Motors and Transformers.

Commutation.—Baily and Cleghorne.—The first part of a paper read before the Glasgow section of the British Institution of Electrical Engineers. The first part of the paper deals with the determination of the contact resistance of dry (not lubricated) carbons on a copper drum. The results are given in diagrams and summed up in formulas. The two diagrams of Fig. 1 show the total losses per ampere collected for different

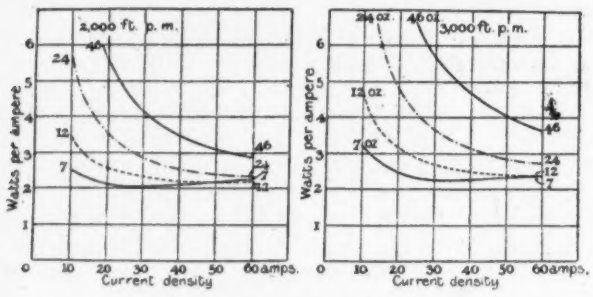


FIG. 1.—LOSSES PER AMPERE.

speeds, pressures and current densities. It will be found that when horizontal lines are drawn through, representing a constant loss, the ratio of current-density to pressure is approximately constant. At a high speed, say 3,000 ft. per minute, a pressure of 7 oz. is the most economical with a current-density of 30, or a ratio of 4 to 1, while at 500 ft. per minute 7 oz. may be used at 9 amperes, 18 oz. at 24 amperes, or 24 oz. at 32 amperes with nearly equal minimum loss, or a ratio of 1.3 to 1. Of course these conclusions will be modified by considerations of sparking and heating, and it may not be possible at high speeds to use the most economical ratio. The power wasted in friction of carbon brushes in watts equals the velocity in feet per second, multiplied by the pressure in ounces per square inch, multiplied by the area in square inches of both brushes, multiplied by a coefficient, which shows some variations on polished surfaces although 0.0005 is a fair average, while at high speeds 0.0004 will be more nearly correct. The action of lubricants is beneficial in reducing friction and wear and tear of brushes, without any counter-balancing increase in electric losses, provided a little attention is bestowed on it. On account of the reduction in friction losses, the pressure may be increased to some 30 or 40 ounces, and over a large range of current-density current can be collected at a total loss of less than 2 watts per ampere. The authors then take up a discussion of what they call the "sparking electromotive force," or the e.m.f. due to a sudden cessation of current in an inductive circuit, which tends to produce a spark at the point of separation. This has no connection with the reactance e.m.f. embodied in various formulas. The sparking e.m.f. is a measure of the failure of the machine to commutate its current in the correct manner. The paper is to be continued.—Lond. *Elec.*, November 23.

Hopkinson Tests of Direct-Current Machines.—Cox.—An abstract of a paper read before the Dick Kerr Engineering Society. The usual method of testing a pair of similar machines on full load by using one as a motor to drive the other, associated with the name of the late Dr. John Hopkinson, was fully described, as well as the modification in which a booster is used. In the latter method the driving power is supplied in series with the motor and generator armatures instead of in parallel. A booster capable of carrying the full armature current of the machines to be tested is required, and a supply of current for exciting the fields. The machines are coupled together mechanically as before, and the motor armature, generator armature and booster armature are connected in series. The connections between the armatures must be such that the motor and generator armatures would revolve in opposite directions if they could. In starting, both machines are excited with the normal field current, then the main armature circuit is closed and the booster excited. The current from the booster is increased to about half-load value and the motor field strengthened until the torque is sufficient to turn the generator round. Then both field and armature current are increased until the machines are on full load.—Lond. *Elec.*, November 23.

Toothed Armatures.—Mueller.—A note with reference to a former paper by Hele-Shaw, Hay and Powell, on the course of the lines of magnetic flux in toothed armatures. He gives a formula which agrees well with experimental results, and which is also useful for calculations.—*Elek. Zeit.*, November 22.

Induction Motors.—Hobart and Ellis.—In a continuation of the serial on design coefficients for dynamo-electric machines, the authors deal with the output coefficient of induction motors and give diagrams illustrating the development of design during the last 16 years.—Lond. *Elec. Rev.*, November 23.

Electric Power in Mines.—Wood.—An illustrated description of the electric equipment of the United States Coal & Coke Co. which is developing the coke and coal lands of the United States Steel Corporation in the Pocahontas coal field of West Virginia. Electric power is used for mining and handling the coal. The potential chosen for direct-current haulage work was 275 volts, as this was believed to give better service on the slow-speed series motors used in mining locomotives; and in some mines working a 5-ft. coal seam, the item of greater safety than with 550-volt current was considered of some value; 440-volt alternating current was chosen as secondary voltage for induction motors on stationary work, while the dimensions of the coal field indicated 6,600 volts as the high potential to be used; figuring approximately 1,000 volts per mile. The main power house now contains two 400-kw and two 750-kw alternators generating three-phase currents at 6,600 volts. Direct current for hauling is obtained from rotary converters installed at the different mines.—*Mines and Minerals*, December.

Peru.—Guarini.—An illustrated article discussing the possibilities of the development and applications of Peruvian water powers. Peru with its rivers descending from elevations of 3,000, 4,000 and 5,000 meters possesses enormous sources of power. The Rimac River alone is capable of developing at least 100,000 hp. By properly damming the Chile River the same amount of power could also be developed. A project discussed at some length by the author relates to a power development in connection with the Lake Titicaca, and from which he believes that 2,000,000 hp could be obtained.—*Eng. Mag.*, December.

Water Supply.—Dixon.—In a continuation of his serial on the plan and construction of power plants the author deals with the water supply and its heating and purification.—*Eng. Mag.*, December.

Boiler Plant.—Schmidt.—The first part of an illustrated description of the boiler plant in the Bavarian Jubilee Exposition, Nuremberg, 1906.—*Elek. u. Masch.*, November 18.

Traction.

Feeding Tramway Systems.—RASCH.—An illustrated report discussing the advantages and disadvantages of feeding tramway systems in isolated zones as compared with closed networks.—Lond. *Elec.*, November 23.

Installations, Systems and Appliances.

Direct-Current Series System.—An article on installations of the Thury direct-current series system. A table is given of 15 different transmission lines using this system. Of these plants the transmission from Moutiers to Lyons is especially interesting since in this the voltage is the highest, namely 57,000, and the distance is a maximum, namely 180 kilometers. The total aggregate capacity of all 15 plants is 24,385 hp. The Moutiers-Lyons transmission which was described in our issue for October 12, 1906, is treated at great length.—*Elek. Zeit.*, November 22.

Wires, Wiring and Conduits.

Heating of Cables.—TEICHMUELLER AND HUMANN.—An account of extensive experimental researches on the heating of multiple-core high-tension cables buried in earth. The authors describe several new experiments on the heating of cables, and then compare the results with their theory. The cables were buried 70 centimeters below the surface, the conductors of each cable being connected in series, and being fed with direct current. The temperatures increase of the copper conductors and of the lead cover was determined by measuring the resistance. With the aid of special copper wire coils placed outside around the cable, the temperature at the surface of the cable was also determined. In their formulas a constant is important which represents the depth below the surface of the earth at which the temperature of the earth is no longer influenced to any considerable extent by variations of the temperature of the atmosphere. By experiments extending over half a year they found that at a depth of 10 centimeters the temperature of the earth may be considered as practically constant during the duration of one experiment (18 hours). The results of their experiments are given in a number of tables and diagrams, and it is shown that the theory is sufficiently corroborated by the experimental results. On the basis of their measurements tables are calculated for three-phase cables and recommended for approval to the committee of the German Association of Electrical Engineers.—*Elek. Zeit.*, November 22.

Cables.—BROOKING.—An article on electric cable troubles. The author discusses how to choose the size of the conductors, the class of insulation, method of construction and manner of protection of electric cables. He also deals with the systems of laying and maintenance, and with respect to these latter points, he discusses especially British practice, namely solid laid cables. *Cassier's Mag.*, December.

Electro-Physics and Magnetism.

Radioactivity.—BOLTWOOD.—A note on the production of radium by actinium. The author refers to the various attempts which have been made to experimentally demonstrate the growth of radium in uranium solutions, and which have demonstrated conclusively that a quantity of radium formed in a given time from a known weight of uranium is very much smaller than would be expected from the disintegration theory if radium was a direct product of uranium. But it is quite possible that some intermediate product of a relatively slow rate of change exists between radium and uranium, and the present author produces strong evidence in support of the assumption that actinium in this intermediate disintegration product.—*Amer. Jour. of Science,* December. A paper by Eve deals with the relative activity of radium and uranium measured by the gamma radiation. —*Amer. Jour. of Science,* December. A paper by Elster and Geitel deals with the production of radioactive substances from ordinary lead; a paper by Hahn with radio actinium, which has an intermediate position between actinium and actinium X. —*Phys. Zeit.*, November 15.

The Effect of a Secondary Current on the Phenomena in Breaking a Circuit.—BENISCHKE.—A mathematical paper in which the author studies the phenomena of the extra current (that is, the current which passes in a circuit after the same has suddenly been broken). He studies especially the effect of a secondary current on the phenomena. The chief result is that when a circuit which is magnetically coupled with another closed circuit is suddenly broken, the extra current and its e.m.f. decrease the more quickly and the heat of the sparks is the smaller, the greater the secondary current and the stronger the magnetic (inductive) coupling of the two circuits.—*Elek. u. Masch.*, November 18.

Electro-Chemistry and Batteries.

Steel Hardening and Annealing Furnace.—An illustrated description of an electric furnace recently shown at a British exhibition. It is especially adapted for hardening and annealing steel. It consists of a rectangular crucible with iron electrodes at opposite ends. The bath consists of pure barium chloride for temperatures between 1,100° and 1,400° C., and of a mixture of barium chloride and potassium chloride at lower temperatures. Alternating current is used in connection with a transformer for regulating the voltage. The cost is stated to be the same if electric energy costs 2 cents per kilowatt hour, as with gas furnaces if the gas costs 29 cents per thousand cubic feet, but with electric furnaces faulty work is stated to be almost unknown and the output to be greatly increased.—Lond. *Elec. Rev.*, November 23.

Bleaching Liquor.—BIGGS.—An illustrated Faraday Society paper describing the municipal plant at Poplar, using the Hermite electrolytic process for making hypochlorite for sanitary purposes; also an abstract of a paper by Digby on some investigations relating to the depreciation of electrolytically-produced solutions of hypochlorites.—Lond. *Elec.*, November 23.

Units, Measurements and Instruments.

Measuring Weak Alternating Currents.—KOENIG.—A communication with reference to a recent description by Voege of a vacuum hot-wire instrument. The present author has used a similar instrument but has employed carbon instead of platinum for the hot wire. His connections of the thermo-element to the hot wire are similar to the arrangement in ordinary incandescent lamps. In order to get the same reading with different directions of the calibrating current, it is necessary to reduce the welded joint to a mathematical point, and this may be practically realized by using a relatively large cross-section of the joint compared with the hot wire. The present author's instruments were made by the Western Electric Company and gave a deviation of 150 millimeters of the galvanometer for a scale distance of 1 meter or 8 millivolts on a Weston millivoltmeter for 3 milliamperes in the carbon filament. He is sure that his instrument will show 0.5 milliamperes for 1 degree of scale of a direct reading millivoltmeter.—*Elek. Zeit.*, November 22.

Phase Displacement in Transformers.—DRYSDALE.—In a continuation of his illustrated article on measurements of small phase displacements, the author takes up the question of the phase differences between the primary and secondary fields and currents in transformers, which is of most vital importance to makers of alternating-current instruments. One result of his experiments is that the lower the resistance of the instrument with a current transformer, the better. A non-inductive instrument of the same total impedance gives much better constancy of ratio with different loads than an inductive one. The chief aim in constructing current transformers for all purposes must be to keep the core induction as low as possible. This, of course, means a transformer of large size and an instrument of low impedance. Concerning the use of potential transformers, it is shown that they may be used with confidence both for voltmeters and wattmeters provided the magnetic leakage is small and the resistance of the instrument large.—Lond. *Elec.*, November 23.

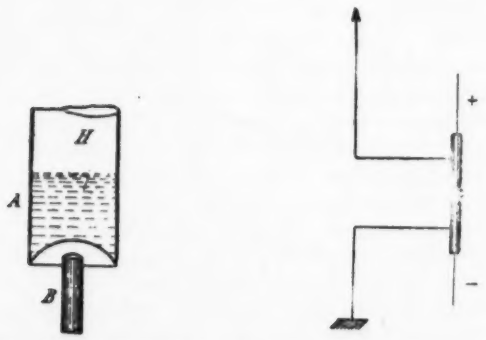
Errors of Compass on Shipboard.—ARLDT.—An article in which the author studies the influence of the currents flowing through the iron walls of a ship upon the indications of the compass needle. He gives two formulas which enable one to determine this influence within certain limits and by means of a numerical example he shows that under certain conditions this influence may cause errors which should be taken into consideration.—*Elek. Zeit.*, November 22.

Photometry.—Tufts.—An account of photometric measurements on a person possessing monochromatic vision. The flicker photometer was used.—*Amer. Jour. of Science,* December.

Telegraphy, Telephony and Signals.

Loaded Telephone Cable.—A note on a recently completed telephone cable, laid across the lake of Constance, in Germany, and fitted with Pupin induction coils. These coils, which are provided at certain intervals, thicken the lead-covered cable considerably in these places, so that the laying was attended by great difficulties. After the failure of the first attempt in the autumn of 1905 with the ordinary type of cable-laying gear, special new apparatus had to be built to deal satisfactorily with the thickened portions of the cable. The latter were reduced to a certain extent by inserting the coils in a different manner. After all these preparations had beee accomplished, a second attempt was made at the beginning of last August. The cable was coiled on a drum about 30 ft. in diameter and 5 ft. high, and was led over rollers to the paying-out machine, provided with dynamometer and brake in the usual way. Before the actual laying of the cable took place, experiments were carried out with a length of 550 yards, provided with several coils, which after a few miles trailing on the bottom of the lake and considerable strain showed no damage. As soon as the laying had begun, a serious fault was discovered which could not be immediately localized. The cable had to be hauled on board, cut from the shore cable, which, however, was found to contain the fault, and operations were started afresh without any further disturbance, so that the work was completed in two hours and a half. Directly after the laying, telephonic communication was obtained with Berlin over the new line.—Lond. *Elec.,* November 23.

Undamped High-Frequency Oscillations. — Hahnemann.—Poulsen has recently shown that by means of the singing arc, undamped electric oscillations of such frequency as to be applicable to wireless telegraphy and telephony, may be produced if the arc is generated in an atmosphere of hydrogen. This is probably to a large extent due to the cooling effect of the hydrogen atmosphere. Elihu Thomson has already pointed out in 1893 the importance of an artificially cooled electrode and of using the proper materials for the electrodes. Copper seems to be the best material for the positive electrode and carbon for the negative electrode. By simply carrying out this scheme, the Telefunken Company has recently succeeded in producing undamped electric oscillations without any hydrogen atmosphere. The arrangement of the electrodes is indicated in Fig. 2, in which *A* is a hollow copper cylinder filled with cooling water. The carbon electrode, *B*, is introduced into the hollow inside of the copper electrode. The use of an arc in a hydrogen atmosphere permits the employment of greater energy than the use of the electrode as just described. But the present author does not think that this is of great importance. By connecting a number of electrodes in series and parallel (similar to the system of connections in Braun's system of wireless telegraphy) it is possible to increase the energy at will. It is, of course, important to maintain all the arcs continuously with as few devices as possible. For this purpose the author mounts several carbon electrodes on a piece of wood which can be revolved around its longitudinal axis. All the carbons are insulated from each other, and the copper electrodes are placed above them. Each carbon is adjusted separately, and then it is possible to switch in or out all carbons simultaneously by a single rotation of the piece of wood. Since the consumption of the carbons is comparatively slow, it is said to be possible to maintain the oscillations for "a very long time" without having to adjust the different arcs. A great advantage of the new system is that it is no longer necessary to use a closed oscillation circuit, coupled by means of induction to the vertical wire. Instead of this method the simple direct arrangement of Fig. 3 may be employed. Besides simplicity it has the advantage that there is no loss of energy. The author thinks, however, that the possibility of producing undamped electric oscillations will not result in a complete abandonment of the present methods of wireless telegraphy. At least at present the undamped electric oscillations have the following advantages: First, that it is difficult to maintain the wave length exactly constant, and second, that there will be difficulty in increasing the energy at will.—*Elek. Zeit.,* November 22.



FIGS. 2 AND 3.—HIGH-FREQUENCY OSCILLATIONS.

Undamped Electric Oscillations.—Brown.—A description of experiments in which he made use first of a Wehnelt interrupter and later on produced continuous high-frequency electric oscillations by discharges between cooled electrodes in air in connection with inductances and capacities. The final arrangement is shown in Fig. 4. The discharge takes place between a disc of metal, preferably aluminum, *W,* which is kept slowly rotating and forms the positive electrode, and the negative electrode, C, which consists of a copper block resting against the edges of the disc. On the passing of a direct current at 200 volts pressure from a supply network, *E E,* through a resistance, R_1, and the self-inductance, L_1, and thence through the disc to the copper block, exceedingly rapid oscillations are produced in the condenser, *K,* shunting the moving contact. The frequency was in some instances of the order of millions per second. The advantage of the moving disc is that it is self-cooling and self-regulating.—Lond. *Elec.,* November 23.

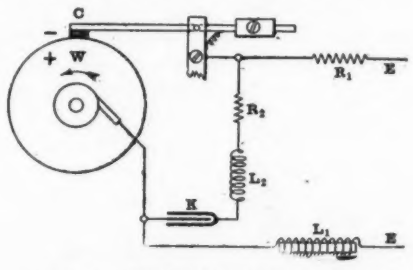


FIG. 4.—ELECTRICAL OSCILLATIONS.

Electric Oscillations.—Drude.—A report on the present status of our knowledge of electric oscillations, with applications to wireless telegraphy. The best system of wireless telegraphy is considered to use a magnetic coupling, and absolutely identical transmitter and receiver. As receiver an iron wire bundle (as magnetic detector indicating change of hysteresis) is to be placed around the coil which is connected to the capacity. The iron wire bundle should respond to the "integral effect"; in this case a sharp tuning between transmitter and receiver can be most easily obtained.—*Phys. Zeit.,* November 15.

Miscellaneous

Presidential Address.—Kennedy.—Extracts of his Presidential address to the (Brit.) Inst. of Civil Eng. He discussed the relation between the engineer and the world at large. "Engineering problems differ from ordinary academically scientific problems, partly in that they are much more complex, and consequently more difficult of anything like exact solution, and still more because—exact or inexact—some solution of them must be found. Not only must the solution be found, but it must be translated into steel and gun-metal, as well as into dollars and cents, and any mistake will entail very much more serious consequences than a controversial paper in the *Philosophical Magazine,* or a letter in *Nature* pointing out a wrong estimate of terrestrial radio-activity in pre-historic epochs." . . . "The mere use of formulæ or of exact calculations of any sort is not in itself scientific. That man shows far more of the scientific spirit who recognizes when his data do not allow of the use of

any exact formulæ, and who, therefore, reasons with what may be called mathematical common sense, than the man who tries to force the facts to fit a class-room formula and arrives at a result which satisfies the formula without recognizing that it bears no relation to the facts." In speaking of railways, the author considers some mountain roads in Switzerland as absolutely unnecessary. "They serve merely to get the public without trouble to places where the public would not otherwise go, and from which they never would be missed." Roads like the Jungfrau road are "violently and impertinently out of keeping with the spirit of their surroundings," and the author wishes that engineers would have nothing to do with them. With regard to specifications and contracts, the manufacturer has one chief and simple duty, namely "to read them" . . . "With some engineers things have occasionally not been thought unworthy or improper which, although not in themselves dishonest, would be impossible among lawyers or doctors, which ought to be impossible among gentlemen, and which would be impossible among ourselves if our organization were as complete and our etiquette as strict as in the older professions." . . . "In looking forward one of the chief directions in which the engineers of the future will carry out successful work will be that of increasing directness, avoiding transformation and greatly increasing the efficiency of whatever transformations remain necessary."—Lond. *Elec.*, November 9.

First Help in Accidents.—An illustrated reprint of the rules proposed by a committee of the German Association of Electrical Engineers on first help in case of accident in electric plants. —*Elek. Zeit.*, November 15.

Diesel Engines for Interurban R. R. Service.

BY NORMAN MCCARTY.

The statement that high-tension transmission for electric railway service is made necessary because of the necessity of installing a steam plant in a few large units centrally located will probably not be questioned. In other words, if a steam plant could be sub-divided into a number of small units, located at intervals in independent stations within the limit of low-tension transmission, the transformer station would probably be discarded and low-tension direct current substituted.

This, however, is impossible with steam units without sacrificing operating economy and if a low-tension system is adopted for long distance operation it must be by installing some internal combustion engine having high fuel economy in small units without a corresponding increase on the cost of operating labor.

The adoption of the alternating-current system (either single-phase or with rotaries) as stated above was necessary because of the difficulty and expense of transmitting a current of large volume and low-tension over long distance from a central generating plant, and is never used where transmission distance is within the economical limits of a direct-current system.

The records of the Diesel oil engine in this country and abroad have demonstrated:

1.—The consumption of fuel per brake hp in the smallest engine is not 15 per cent greater than that of the largest units, and in every case is within the builders' guarantee of 12½ gal. of oil for each 100 kw-hours, delivered at the switchboard under the operating conditions of the system as proposed in this article. The actual fuel consumption of a 225-B.h.p. unit at full load is 10¼ gal. for each 100 kw-hours at 90 per cent efficiency of the generator.

2.—That the consumption of fuel per brake hp is practically constant from one-half load rated capacity of the engine.

With the above facts established as they have been by the records of many plants in actual operation, there should be no objection to the installation of Diesel oil engines for the work in so far as relates to fuel economy. It is also safe to assume that the actual labor required to operate a number of Diesel primary stations will be less than that required for a central steam station together with that needed for the necessary transformer stations.

The only objections to be raised would refer to the continuity of service, the extreme variation in the load and small overload capacity of the internal-combustion engines, but the installation of a small storage battery in each station successfully meets all of these objections, and the desirability of the installation of Diesel engines and low-tension direct-current as a substitute for steam equipment and high-tension current, either with transformers or single-phase motors, becomes merely a question of first cost and future operating economy and the following is offered as a close estimate of the comparative cost for installation and operation of a 50-mile road, with 50-ton cars operating at 30 miles per hour on one headway and for 18 hours per day.

Length of road, 50 miles. Maximum speed of cars, 30 miles per hour. Number of cars, 5. Weight of cars loaded, 50 tons. Average kilowatts per car, 100 (70 watts per ton-mile on low-tension bus-bars). Number of power stations, 4. Equipment of each station, one 150-kw, direct-current, 650-volt unit and one 240 amp.-hour battery. Four engines deliver a total of 600 kw per hour and 16 hours of actual operation at full load would be sufficient for engine service, making a total output of 9,600 kw-hours per day. The storage batteries would operate the road for the balance of the day, including owl cars and light and power for car barns when engines were idle. One 240 amp.-hour battery per station would be absolutely safe for the purpose.

The total oil fuel required would be $96 \times 12\frac{1}{2} = 1{,}200$ gals., which at 3 cents per gallon would cost $36. The labor required for operating four stations would be as follows, divided into two shifts of 10 hours each:

One chief engineer and electrician, per day	$ 5.00
Eight assistants at $3 per day	24.00
Total labor per day	$29.00

Supplies (lubrication and waste), $1.50 per day for each station, or for four stations, $6.00 per day.

The total operating expenses would be as follows:

Fuel	$36.00
Labor	29.00
Supplies, engine	6.00
Total	$71.00
Cost per kw-hour (fuel, labor and supplies)	7.4 mills
Cost per car mile (fuel, labor and supplies)	26.5 mills
Cost per ton mile (fuel, labor and supplies)	0.53 mill

The Diesel engine station, however, would deliver to the low-tension feeders all of the current generated, while the steam plant operating through high-tension lines with transformers and rotaries would probably not do better than 65 per cent, so that a steam plant must deliver current on the switchboard at the cenral power house at not to exceed 5 mills per kw-hour for fuel, labor and supplies to equal the economy of the Diesel engine for current delivered to the low-tension feeders.

A discussion of the cost of operating a steam plant is perhaps unnecessary, as this cost will vary with the type of engine installed and the peculiarities of the installation; but in order to make a comparison we will assume that a fair coal consumption for a steam plant of this size operating under the described conditions would not be less than 3½ lbs. per kw-hour, as shown by wattmeter readings on the primary station switchboard. At $2.50 per ton of 2,000 lbs. this would represent a cost of 4.375 mills for coal alone, to which must be added labor and supplies at the primary station and labor at the sub-station which would probably represent 3 mills additional per kw-hour based on 10,000 kw-hours per day of 18 hours, or a total of 7.375 mills per kw-hour delivered at low-tension feeders against 7.4 mills for the Diesel, a saving in favor of the Diesel system of about 25 per cent of the steam cost. Furthermore, the fuel cost per kw-hour as shown for the Diesel installation is at least 20 per cent higher than actual records show for this type of service, and can be guaranteed, while no one will guarantee the fuel consumption of a steam plant. However, it must be left to the experience of the operator to decide for himself whether or not his steam plant can deliver one kw-hour on the primary station switchboard at a cost of 5 mills under the varying conditions of an electric railroad load, this cost to include every item of expense connected with the main and sub-stations except interest and depreciation.

As the amount of low-tension copper would be exactly the same regardless of the system installed, this cost can be eliminated from the comparison of the two systems, so also the cost of the track and bonding.

The cost of each rotary station building would about equal the cost of the building for each Diesel station, and we have only to compare the cost of the steam plant, electrical equipment and building, plus the high-tension line and transformer station equipments against the cost of the Diesel engines with generators and storage batteries as follows:

Each Diesel station consisting of one 225-hp engine, one 150-kw, direct-current generator and switchboard, and one 240-amp.-hour, 640-volt battery, completely installed, including foundation for $35,000, or for four stations, $140,000.

The Diesel system contemplates an installation capable of delivering a total of 600 kw on the bus-bars with practically no losses between switchboard and low-tension feeders, but with losses of 35 per cent for the high-tension system. Between these points we must install at least 750 kw in the steam station to include these losses and peak loads in order to get a corresponding average output of 600 kw on the low-tension side of the sub-stations.

A steam-driven plant for a road of this character, however, would usually install in the power house two 600-kw units, one of which would act as a reserve under usual operating conditions.

Each sub-station would, in all probability be equipped with two 300-kw rotary equipments, including step-down transformers and devices necessary for their operation, one of the 300-kw units being relied on as a reserve capacity. A fair average cost of this equipment using rotary sub-stations would be about as follows:

1200-kw steam stations including engines, boilers, stack, generators, step-up transformers, switchboard and auxiliaries at $95 per kw completely installed	$114,000
Building foundations	15,000
50 miles, 3-phase, high-tension line at $650 per mile	32,500
4 transformer stations, equipment complete	64,000
Total	$225,500

This shows a saving in first cost of $85,000, or about 60 per cent at the cost of the Diesel system.

The installation of the storage battery in connection with the Diesel engine would eliminate any necessity for reserve generating apparatus, as the combined capacity of the generating equipment and storage reserve in each station would be equal to the demand for intervals long enough to meet the extreme operating conditions or peak loads.

The items of interest and depreciation (repairs) are in favor of the Diesel installations, as the first cost is less than that of a high-tension system, consequently less interest charges and even if we assume, to avoid argument, that repairs on the Diesel engines are equal to the combined repairs of steam engines and boiler installations, the expense of maintaining the high-tension line and transformers would greatly exceed the expense of maintaining the storage batteries connected with the Diesel system.

The above statement, as presented, is exceedingly conservative and probably more favorable to a steam-driven high-tension system than the average figures for actual operation on a system of this size would show.

The advantages of the Diesel low-tension system are, therefore, presented as follows:

The greater simplicity of the low-tension system as compared with any type of high-tension. The greater safety of the low-tension system. A saving of at least 35 per cent in first cost. The elimination of all troubles peculiar to high-tension current due to the transmission line and transformers. The storage batteries furnish absolute guarantee for continuous service. The engine can be operated for a specified fixed time at full load and highest fuel economy and can be shut down for short periods without affecting the car service. A saving of at least 33 per cent in actual operating expense. A saving in interest charges because of the smaller first cost. A saving in repairs and depreciation by eliminating the principal causes for this expense connected with a high-tension system.

Perhaps the strongest argument to be represented in favor of the system proposed next to its simplicity and operating economy is the advantage of being able to build for present needs without in any way affecting the economy, reliability, or flexibility of the line as future extensions become necessary or additional service added to each station as the service develops and demand for power increases.

The investment can be limited to the immediate necessities without any thought as to future extensions and heavier traffic, with the advantage of decreased interest charges and a much higher operating economy, because the generating units installed are always properly proportioned to the service as it exists at that time.

The smallest system representing a small amount of capital invested can be used as a nucleus for unlimited extension or branches and for the heaviest service without sacrificing any of the original investment, nor in any way reducing the operating economy or efficiency of the original installation.

Electrically-Driven Steel Plate Engraving, Imprinting and Embossing Machine.

By D. P. Bandy.

Every one who has ever had occasion to use engraved stationery knows how very expensive it is, and no doubt many have wondered why, with all the modern improvements in the arts of engraving and printing, this should be so. The reason is no mystery, however, as will be obvious when it is stated that the great expense is occasioned by the use of hand labor throughout the entire process, and hand labor, especially where it is highly skilled, costs money. Even the most highly skilled engraver works exceedingly slowly, and with his graver cuts laboriously each letter into the steel block, chip by chip. The average number of letters he is enabled to produce in a day's work is about one hundred, and as he gets five cents per letter for his work and his employer charges his customer seven cents per letter it counts up very quickly, and these figures are for plain letters at that.

When the die has been finished by the engraver it is handed to the stamper, who prepares it for making the impressions on the card, envelope or letterhead. There are several processes to go through with and each requires precision and time. After a counter is made it is glued to the die and the latter is well inked by means of a brush; since the ink is distributed completely over the surface of the die, it must be carefully wiped off, but leaving the letters well filled, for if the slightest trace remains on any part except in the depressed letters, the paper will of course be smeared, and the sheet wasted. The ink remaining in the letters sunk in the die is to be utilized in making the impression, and after the sheet of paper is adjusted the screw of the hand press—not unlike that used by Franklin—is turned until the die strikes the paper and forces it up and into the letters, which not only imprints it but embosses it at the same time. The die is then raised, the sheet is removed and laid away to dry, when the cycle of operations is repeated. The maximum capacity of a skilled stamper operating a hand press is about one thousand impressions per day. A line of machines designed and built by the National Steel Plate Engraving Company, illustrated herewith, promises to revolutionize the old practice as above sketched out.

The new machine for cutting steel dies involves the parallelogram principles of the pantagraph, but the levers instead of lying flat are arrangd vertically through the mechanism, which constitutes an instrument of precision, makes mechanically a copy of original or pattern letters on a steel block, but on a considerably reduced scale. The pantagraph is swung from a rigid upright frame, the lower end of the former having a stylus attached to it. The name or other words to be engraved is set up in a slot in the table with the aforesaid pattern letters—letters that are fifteen or twenty times as large as the engraved ones will be when finished.

On the upper end of the pantagraph movement a revolving routing-out tool is rigidly supported, although its vertical movement can be controlled within certain limits by the operator, and a pulley belted to a small electric motor causes it to revolve at a speed of about 4,000 r.p.m. Immediately under the routing tool the steel block to be engraved is clamped to a work bed and by a treadle under the machine worked by the boy in charge, the block may be brought into contact with the tool and by tracing

cuts a similar though much reduced letter into the plate. By means of a micrometer attachment the depth to which it is desired to cut the letters may be previously determined upon to the thousandth of an inch. The pattern letters are interchangeable and may be set up to spell out words like ordinary type while there are numerous different designs to select from.

With this machine instead of a highly skilled engraver, a boy only is required to guide the stylus, and as the pattern letters are large and are the work of artists the completed die is much more accurate than where the die is cut by hand. A boy operating one of these engraving machines is capable of cutting three hundred letters per day, and it makes no difference whether the letters are plain or elaborate.

Without some mechanical means to keep up with the output of the engraving machine the dies produced by the latter would be of little service, and so after the device was perfected the company's chief designer, Mr. William S. Eaton, took up the matter of providing a mechanism that would be to the hand stamper what the engraving machine was to the hand engraver. His endeavors resulted in a modified printing press being operated by a 5-hp electric motor and different from the ordinary job printing press in that it is provided with a movable bed in

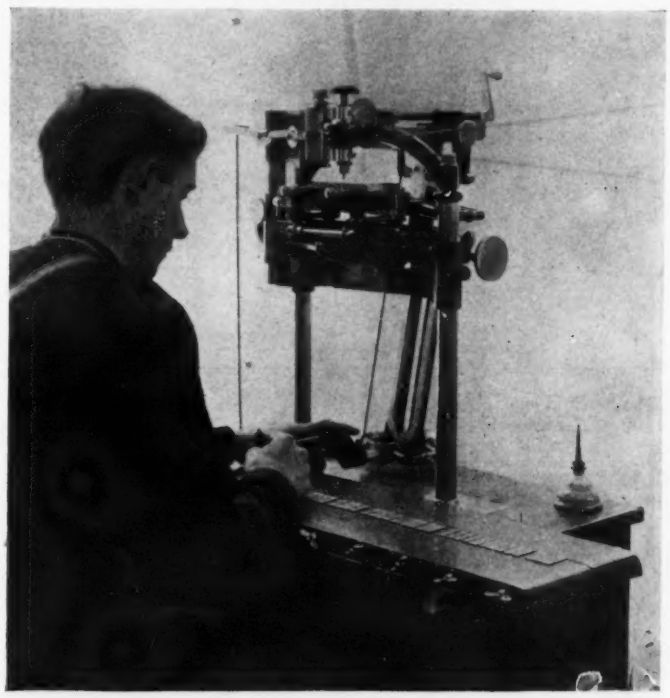


FIG. 1.—ELECTRICALLY-DRIVEN ENGRAVING MACHINE.

which the die is placed, the letterhead or other piece of stationery being placed upon a platen of the usual type; an inking roller rubs the ink into the cut letters. Perhaps the most ingenious part of the press is that involved in the mechanism that wipes off the superfluous ink from the surface of the steel plate. This consists of a roller made of a yielding material arranged so that it will revolve upon a rod attached to the opposite sides of the frame. Connecting rods carrying a heavy weight are provided for the purpose of exerting a uniform pressure which holds the wiping roller against the surface of the die plate. A continuous strip of paper, taken from a roll supported above the machine, passes around the wiping roller so that the surface of the paper that cleans the ink from the die is changed every time the latter is inked, and by means of a cam the paper is drawn sharply around the roller and against the die, this action being so timed that it takes place when the roller is upon the die plate. In this manner the surface of the latter is effectively cleaned.

When the press is set into operation by the electric motor the platen carrying the piece to be printed and the bed carrying the die are brought from an open position, shown in Fig. 2, when the stationery to be impressed and embossed is fed into it to a closed position, when the work is done. During the time this movement is being consummated the roller inks the surface of the die and the cam striking an arm connected through a rod and spur causes a pawl to draw a short length of the paper from the roll over the surface of the roller and this, on moving

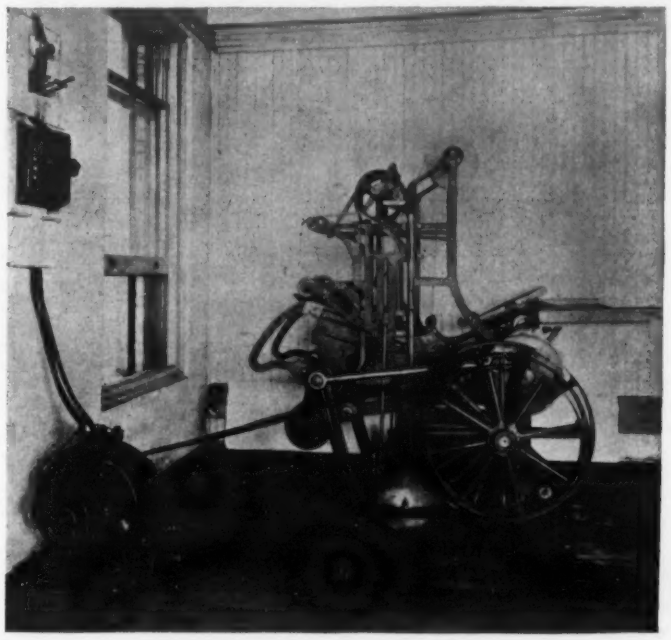
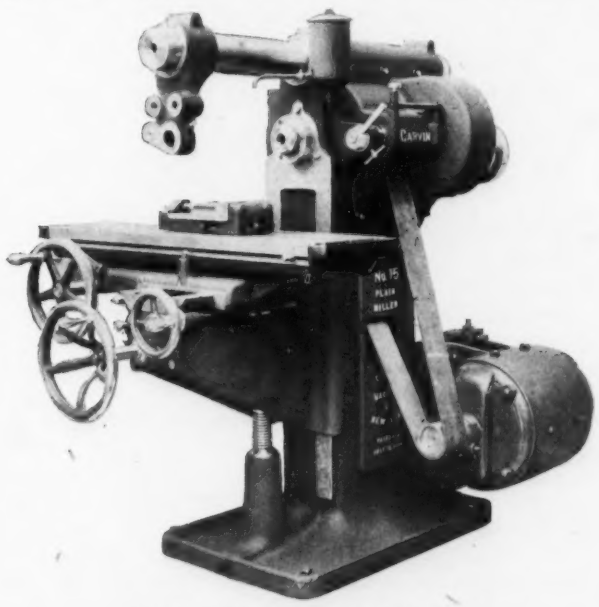


FIG. 2.—ELECTRICALLY-DRIVEN STEEL PLATE EMBOSSING MACHINE.

out of the way wipes the die perfectly clean. The capacity of one of the power presses with a boy as operator is ten thousand impressions per day.

Motor-Driven Plain Milling Machine.

The application of motor drive to machine tools, in addition to a saving in expense for energy, and a general increase of light and air in the shop, offers great advantages in the close regulation of speed obtained, whereby the cutter can be run at the exact speed required, resulting in an increase of output, which may amount to from 10 to 20 per cent, as compared with the ordinary drive, where the speeds available are too fast or too slow for a certain cutter. To render these advantages available to the widest extent and in the simplest manner, is the object sought in the application of motor drive to the plain milling



MOTOR-DRIVEN MILLING MACHINE.

machine, illustrated herewith, as made by the Garvin Machine Company, New York.

A 3-hp direct-current motor, having a speed variation of 3 to 1 is belted direct to a large pulley on the spindle, in combination

with a double back gear, giving a range of 14 to 480 r.p.m. There are three stages of speeds direct to spindle, through fast back gear and through slow back gear, and in each grade the speed ranges from 1 to 3, and between these limits there are 24 changes, and for the total range of 14 to 480, there are 72 changes. This covers a wide range, varying by finer steps than is obtained by constant-speed pulley and change gear box methods. Changes in the back gear ratio are made by moving the lever shown on the top of the back gear cover, the gears being brought into position by the lever, and thrown into engagement by the eccentric handle, an arrangement which makes it impossible to smash the gears by sliding them sidewise into engagement while running.

To drive from the motor to the spindle a belt is used instead of a chain, as the belt is more efficient and durable under high speed and heavy load. The motor is mounted on an angle plate, bolted to the column, and fitted with a screw adjustment to tighten the belt. The rheostat and other fittings not seen in the picture are mounted together on one plate on the front side of the machine, under perfect control of the operator. The weight of the miller complete is 3,400 lb.

Indicating Plug Fuse for 250 Volts.

What is stated to be the first 250-volt indicating plug fuse offered to the trade has recently been placed on the market by the D. & W. Fuse Company, Providence, R. I. The fuse receptacle is shown full size in Fig. 1, while the operation is indicated in Figs. 2 and 3, Fig. 2 giving the appearance of the label before the blowing of the fuse, and Fig. 3 showing the same fuse

FIG. 1.—FULL-SIZE VIEW OF PLUG FUSE.

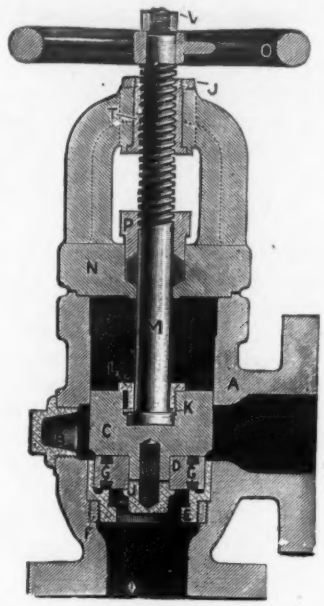
FIGS. 2 AND 3.—FUSE BEFORE AND AFTER BLOWING.

blown as indicated by the black spot within the circle. This fuse is especially advantageous for installations where the wires are exposed to view because the Edison plug cut-out is very neat and compact. It is noteworthy that the fuse can readily be renewed at the factory so that by returning the old fuses the cost of maintenance can be kept quite low. The fuse has been approved by the National Board of Underwriters.

An Improved Blow-off Valve.

The cut herewith illustrates an improved design of blow-off valve, which embodies a number of important features. In the sectional view it will be seen that the plug, *C*, carries a reversible double-faced disc, *D*, secured to plug *C* by stud *B* and nut *J*. This plug *C* is guided perfectly in the valve body, *A*. The bronze seat ring, *B*, is screwed into a second brass ring, *F*, the object of this being to make it possible to renew *B* very easily in case the cone is worn. At the back of the valve is a plug, *S*, the use of which is to permit the introduction of a rod to clean out the blow-off pipe when desirable. The stem, *M*, which raises and lowers the disc, *C*, is held in place by lock-nut, *L*, which is prevented from unscrewing by non-rotating washer, *E*. The threads of the stem, *M*, operate within the bronze bushing in the top of the yoke, which bushing can easily be removed.

It will be seen from his description that all parts of the valve have been so designed that they can be easily renewed when worn or broken. The disc, *D*, having two Babbitt-faced bearings, *G G*, can be replaced at small cost, or the user of the valve



IMPROVED BLOW-OFF VALVE.

can melt out the old Babbitt and pour in new metal, and, after this is faced off, the disc is as good as new. This article is constructed by the Lunkenheimer Company, Cincinnati, Ohio.

Allis-Chalmers Equipment for Chicago Elevated.

Two new Allis-Chalmers engines, 38 in. by 80 in. by 60 in., of the vertical cross-compound condensing type, heavy in construction and suitable for electric railway work, have recently been installed in the power house of the South Side Elevated Railway, Chicago, Fortieth and State Streets. These engines are equipped with Corliss valve gear, with steam and exhaust valves located in the cylinder heads and operated by separate eccentrics. The valve gear is arranged to vary the point of cut-off from 0 to ¾ of the piston travel. The cylinders are proportioned to give the maximum steam economy at a normal load of 3,000 indicated hp, but each engine is capable of developing continuously 5,300 indicated hp with a steam pressure of 165 lb. per square inch, measured by steam gauge at the throttle, and with a vacuum in the exhaust pipe of 26 in. The engines are designed for a speed of 70 r.p.m. and a stroke of 60 in. Each is direct-connected to a 2,000-kw, 640-volt, direct-current generator.

Electrical Workers' Ratchet Screw Driver.

The spiral ratchet screw driver, illustrated herewith, has been designed for use where a large number of screws are to be driven and a light weight tool is required. It is especially advantageous for electrical workers. The bits are straight, so they

SPIRAL RATCHET SCREWDRIVER.

can be used to drive screws through holes in insulators, etc., where flattened blades will not pass through holes. It drives screws in or out, ratchets in or out, and is arranged to hold rigid when closed or extended. It is small enough to be conveniently carried in the pocket, measuring 7 in. long when closed (without bit) and weighing complete less than 7 ounces. This screw driver is made by the North Bros. Mfg. Co., Philadelphia, Pa.

Kryptol.

BY J. E. FRIES.

Kryptol is the name given to a new material, which introduced as resistance in an electric circuit serves to transform electric energy into heat. It was invented in Germany and in its newest form brought into the market by a Bremen concern, "Kryptol-Gesellschaft." As Kryptol already has come into considerable use in several European countries, a brief description will here be given of its qualities and the several purposes to which it readily lends itself.

Kryptol is a heterogeneous mass composed of graphite, carborundum and a smaller part of other substances, the amount and

FIG. 1.—BATH.

nature of which determine the relative conductivity of different mixtures. It may be used for both direct and alternating-current circuits. If it is spread on an insulating bedplate between two pole pieces connected to an electric source of supply and the circuit is closed, there will, to begin with, be established small arcs between the different particles, but as the conductivity grows

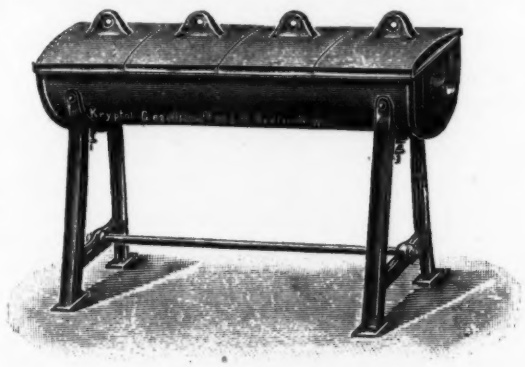


FIG. 2.—OVEN.

with rising temperature, this phenomenon disappears, the whole mass becomes glowing and the radiating heat will be due to the energy consumed by resistance. As Kryptol is unmeltable at any temperature, as yet obtained, the only heat limiting feature is

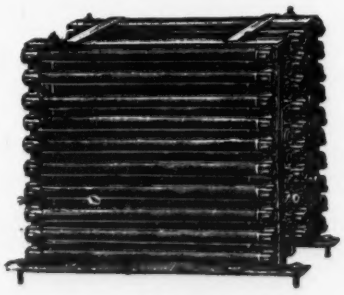


FIG. 3.—SHELL RADIATOR.

the combustibility of its bedplate. Some ovens are built for a temperature of 2,000° C. By varying the thickness of the Kryptol layer and also by using different compositions, different temperatures may be obtained in the same bath. The same means are of course used in order to adapt similar apparatus to different voltages.

In a chemical laboratory glass and porcelain vessels may be put direct on the heating mixture, for although the graphite in contact with air will gradually burn, yet this process is so slow that the cost for the necessary new Kryptol is negligible. Also in the rheostat building industry Kryptol is more and more becoming a factor to be taken into account. Obviously it has especially found use in connection with other Kryptol apparatus, such as ovens, for instance, that require very close regulation. When used for heating air, as in radiators or drying ovens, the Kryptol is enclosed in insulating tubes, generally glass tubes.

In such heating apparatus each unit called a "Kryptol-shell" by its inventor, Dr. Volker, will consist of the glass tube filled with Kryptol and pole pieces of brass fitted air tight to the ends of the tube. A suitable frame is provided with spring clips into which the "shell" may be pressed after the cartridge fuse fashion. This construction makes the units easily exchangeable, but as

FIG. 4.—SHELL DRYING BOX.

their resistance is adapted to cause a rise of temperature seldom exceeding 100° C., the life of the "shell" is long and their exchange, therefore, not often necessary. They are guaranteed for 3,000 hours, but many have been found as good as new after 10,000 hours' use.

By providing a shell radiator with a controller whereby a smaller or larger number of units may be cut out from the circuit, a most ideal radiator is obtained never "burning" the air and extremely easy to regulate.

Laboratories, model kitchens, steamers, electric trains and street cars are a few of the places where Kryptol is coming into extended use, and eventually whole communities, where electric energy is cheap, will profit by the invention. The big steamship company, Nordeutscher Lloyd, for instance, has equipped the staterooms on their passenger boats with Kryptol "shell radiators." This heating system is at present on trial also on the experimental electric railway of the Swedish Government.

Power Plant Auxiliary Equipment.

In a lecture before the National Association of Stationary Engineers, Illinois No. 1, of Chicago, Mr. R. D. Tomlinson, past-national president of the association and condenser expert of the Allis-Chalmers Company, Milwaukee, dealt vigorously and at some length with a subject on which there has arisen of late a good deal of discussion. Mr. Tomlinson, whose knowledge at first hand of all of the latest improvements in the mechanical engineering field, and especially in relation to the auxiliary equipment of modern power stations, fitted him to talk convincingly, emphasized one or two points rather strikingly. All machinery outside of boilers, main engines and generators was classed as auxiliary apparatus, and, according to Mr. Tomlinson, the two features to be obtained from that equipment are, first, reliability; then efficiency; for a shut-down, even for a short time, causes material loss. Some auxiliaries are necessary for all plants; the question to decide is what apparatus will be sufficient to make the plant efficient without undue complication. The speaker criticised, in particular, the common use for various purposes in the power plant of a large number of direct-acting

pumps, consuming from 60 to 200 or more pounds of steam per horse-power, depending upon the mechanical condition of the pumps and the conditions under which they are operating. The majority of the direct-acting pumps in use are "short-stroking."

Within the past few years there has been developed to the highest state of efficiency a line of compound horizontal crank and fly-wheel pumping engines, with Corliss liberating valve gear, of a capacity from ¾ of a million to five million gallons, and in a vertical type from ½ to five million gallons daily capacity, especially suited for elevator service and work of a similar nature. The builder, the Allis-Chalmers Company, guarantees a saving of fuel for equal work of at least 40 per cent over the type of direct-acting pumps now in general use in office buildings. The main reason for the installation of the direct-acting type of pump is the small floor space which it occupies and low first cost, but when the enormous saving in fuel is considered and the fact that boiler capacity can be reduced in accordance with the reduction in steam consumption, the power user can well afford a little more floor space and to pay the difference in price.

Slide Wire Bridge.

The location of faults in circuits made up of low resistance conductors, such as power cables, involves the reduction to a minimum, of all contact resistances both external to the apparatus used for such purposes and in the apparatus itself.

The importance of small contact resistances is evident from the fact that all such resistances will enter as an error in the measurement. If, for instance, a contact resistance should amount to .001 ohm and the cable be of such size that .001 ohm equal the resistance of 20 ft. of the cable, there would be an error in locating the fault by this amount. Most of the errors in localizing faults by the loop method are due to the resistance of the connections being disproportionately high.

The Leeds & Northrup Co., of Philadelphia, has placed upon the market a slide wire bridge which has embodied in its design a construction which eliminates the errors due to lead wires and their contact resistances, and which is shown in the accompanying illustrations.

The bridge wire is made large, so that it will easily carry a

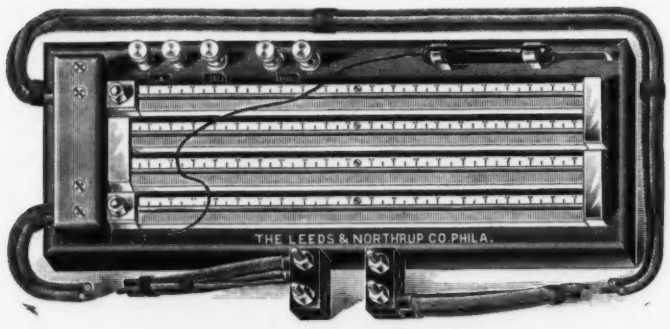


FIG. 1.—SLIDE-WIRE BRIDGE.

large current and thus give a good sensibility for locations even on cables of large cross-section. The wire is subdivided into a thousand divisions, each of which is 1/16 of an inch.

The errors due to resistance of leads and contacts are avoided by providing the two ends of the bridge with 8 ft. of flexible cable of a large cross-section. At the leads are heavy contact blocks for clamping on to the end of the cable to be measured or they may be connected directly to the switch in which the cable terminates.

The galvanometer contact is made at the clamps at the end of the flexible cable so that the cables are included in the bridge wire and are allowed for in the calibration of the bridge wire.

The arrangement of the connections including the lead cables and galvanometer contacts is shown in Fig. 2.

The clamps at *A* and *C* must be so fastened that the contact resistance will be very small. For the same reasons, all contact resistances throughout the loop from *A* to *C* must be made negligibly small.

The battery and galvanometer are to be connected in at the binding posts marked *Ba* and *Ga*, respectively, and the binding post, *Gr*, is to be grounded. It will very frequently happen

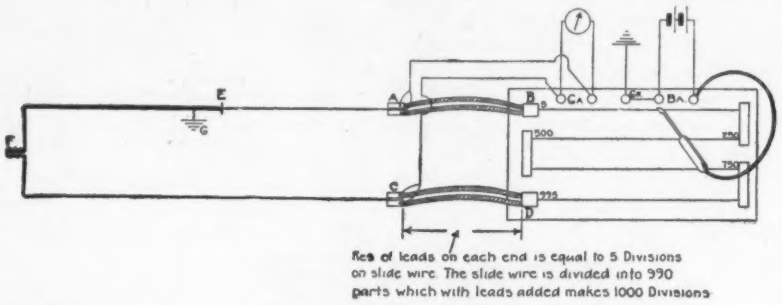


FIG. 2.—DIAGRAM OF CONNECTIONS.

that the ground is to the cable sheath or some other conductor. In these cases, the binding post, *Gr*, should be connected to this conductor. Sufficient battery capacity should be used to give a readable deflection on the galvanometer for a small movement of the contact on the bridge wire.

The fault is located by the usual Murray formula. If, for instance, the galvanometer shows no deflection when the contact is at 300 on the scale, it would indicate that the fault is at a distance from *A* equal to 300/1,000 of the total length of the loop from *A* to *C*.

Annual Show of the Automobile Club of America.

The seventh annual show of the Automobile Club of America was held in the Grand Central Palace, New York, December 1 to 8. If the substantial list of exhibitors indicates anything at all, it is the vast proportions and stability which this industry has assumed. Everything connected with the industry from the costliest car made to the smallest accessory was on exhibition; but the number of electric pleasure and commercial vehicles shown would indicate that the use of this class of vehicle is diminishing, whereas the opposite is true. Ponderous touring cars were exhibited in large numbers, and it would appear that the tendency of the builders is toward larger and more expensive cars rather than to low-priced cars manufactured in quantity and available for the man of moderate means.

With the exception of possibly half a dozen cars, gasoline vehicles monopolized the entire show, and of these all but two operate on the four-stroke cycle. The majority of the engines have four cylinders and ignition of the mixture is for the most part by jump-spark. Storage batteries and dry cells are used for ignition purposes, the former in large cars and the latter in small runabouts; but the magneto and the small direct-current dynamo are becoming more popular. There are no radical departures such as were on view at previous exhibitions, although many meritorious developments were shown for the first time.

The larger of the two electrical exhibits was a four-motor, four-wheel drive truck made by the Commercial Truck Company of America. The motors, one driving direct on each of the four wheels, are swung on bearings in the yokes formed in each end of the cast bronze axles, with steering gear connected to the rear as well as to the front wheels, to be disconnected at will. The speed of the vehicle is 6 miles per hour with a work radius of 30 miles. The Lansden Company, of Newark, N. J., showed one type of express wagon, 65 of which were supplied to the Adams Express Company this year. The frame is of the armored type, the single motor being swung on the frame in any position desired and is thus not subjected to the severe strains and shocks occasioned by rough roadways. The controller gives three or four forward and two reverse speeds, without interruption of the current. The drive is entirely by chains and sprockets. There are three chains: one from the motor to the cross differential countershaft and two from the ends of the countershaft to the

rear driving wheels. The wagon and also the "Electrette" two-passenger car exhibited are supplied with Edison batteries. The Woods Motor Vehicle Company, of Chicago, showed a line of electric pleasure vehicles, including a new French style brougham, an extension landaulet, a victoria and a victoria chassis. However small the space allotted to commercial vehicles, their importance was emphasized by making them part of the general exhibit, albeit in a space specially set apart for them in the gallery. Heretofore commercial vehicles were placed in out-of-the-way corners or in the basement. It would, of course, be out of the question to allot space for every form of commercial vehicle on the market, especially in a show of this kind, which is looked upon more as a parade of pleasure vehicles. Some of the accessory exhibits follow:

American Electric Novelty Manufacturing Company, New York, showed a line of "Ever-Ready" specialties, among which were flash lamps, cigar lighters, dashboard clocks, etc. The engine starter made by the company has been improved and decreased in size. A new speedometer working on the principle of a centrifugal governor and reading up to 65 miles per hour was also shown. C. Hubert, W. Mills, P. Fiske and A. Hollender were in charge.

Atwater-Kent Manufacturing Company, Philadelphia, Pa., exhibited a new model of its spark generator, together with the company's regular line of pocket meters and battery testers. The spark coil generator consists of a spark coil, switch, contact maker and secondary distributor, concentrated into one unit about the size of a coil box. The device is mounted on the dash and is driven from the cam shaft of the engine by means of shaft and gears. There are no magnetic vibrators, commutators or moving wires, and only one adjustment in the outfit. A low-reading ammeter for showing the current consumed by a coil also formed part of the exhibit, which was in charge of A. A. Kent, assisted by E. D. Dunning and C. B. Lucas.

Connecticut Telephone & Electric Company, of Meriden, Conn., made a display of spark coils, indicators, meters, switches, a timer and a combined timer and distributor. The spark coil is made up on the unit system, the units being interchangeable and self-contained. The vibrator is adjustable and all connections for the primary and secondary circuits are made on the bottom of the case. The switch is of the lock type with a removable lever, and on the back edge is a soft rubber gasket to prevent water running down and partially short-circuiting the wires. E. C. Wilson, B. C. Rogers, C. W. Cuno, M. A. Lawton, T. F. Russell, D. L. Herman, C. J. Connolley, B. F. Spitzer and others were in attendance.

Dayton Electrical Manufacturing Company, Dayton, Ohio, showed a working exhibit of the Apple igniting and lighting apparatus. In this system a small enclosed direct-current dynamo is employed to furnish current for the ignition when the speed of the motor rises to the proper point. The dynamo also serves to charge the ignition battery, which is used in starting. An adjustable friction wheel is driven by the fly-wheel of the engine and motion is transmitted through a ball bearing flexible shaft to the dynamo. The speed of the dynamo is automatically controlled by a governor attached to the friction wheel so that no matter what variation there may be in the engine speed the speed of the dynamo is fairly constant. The dynamo charges the battery in proportion to the battery's discharge and the current which is distributed through a timer to coils and plugs is taken from the battery at all times. The operation of cutting out the dynamo when the speed drops below a predetermined amount is performed automatically. Among those in attendance were V. G. Apple, R. L. Huber, H. F. Apple, A. A. Allen, F. J. Allen, L. F. Ross and R. V. Sutliffe.

Detroit Lubricator Company, Detroit, Mich., had on exhibition two models of Hodge force feed lubricators. These are made in various sizes and are handsomely mounted in mahogany cases. Mr. W. P. Wilson explained the operation of the lubricators.

Elbridge Electrical Manufacturing Company, Elbridge, N. Y., showed its ignition dynamo for automobiles and launches; also the Duro battery, together with a full line of lamps and fittings for autos. A new charging panel was shown consisting of a panel upon which is mounted a motor-generator for reducing the line voltage to that required for charging the battery, a voltmeter, an ammeter, a rheostat, switches and an automatic cut-out. The lighting arrangement consists of a panel which is mounted on the dash and which is equipped with plug switches governing the various lamps, a voltmeter, an ammeter and a switch which throws the lamps in either a six or ten-volt circuit. Three or six cells are provided for supplying the lamps and also the ignition current for the spark coil. The cells are charged by a generator driven from the engine. J. Gordon and E. W. Graef were in attendance.

Electric Storage Battery Company, Philadelphia, Pa., showed a number of its pleasure and commercial vehicle types of Exide battery as well as several types of Exide sparking cells. The product of this company is familiar to our readers so that a description of the exhibit is unnecessary. Albert Taylor, T. B. Headley, F. F. Sampson and F. B. Neely looked after the visitors.

General Electric Company showed a number of mercury arc rectifiers, consisting of a single-circuit panel for charging batteries, an eight-circuit panel for garage work, a single-circuit private switchboard, a six-circuit garage panel and an ignition battery panel. A line of the company's standard electric motors for automobile service was also a part of the exhibit. W. D. Jennings and H. C. Van Weelden were in charge of the exhibit.

Gould Storage Battery Company, New York, made a display of its automobile storage batteries and ignition batteries. Sections of both batteries and their component parts were also shown. The ignition batteries have both plates of the pasted type. Stress was laid on the secure grid formation of the plates of the batteries that the contact with the active material may be perfect. The company had a complete tray of batteries ready for installation in commercial vehicles as well as a line of sparking batteries. The exhibit was looked after by W. H. Conant, assisted by C. M. Ripley and H. A. Fay.

Hess-Bright Manufacturing Company, Philadelphia, Pa., made a very large and complete exhibit of the well-known Hess-Bright ball bearings. A large frame extended across the booth on which was arranged in neat series the ball bearings made by this company. In the center was a bearing measuring a foot in diameter, while at the ends were bearings 1¼ in. in diameter. Bearings were shown for all classes of service, and motors, crank shafts, transmission change gear cases, various auto hubs, axles, etc., fitted with ball bearings formed part of the exhibit. A great many of the automobiles shown in the exhibit were fitted with the ball bearings of this company. The exhibit was in charge of H. Hess, assisted by F. R. Bright, E. J. Bachle and A. K. Nair.

National Carbon Company, Cleveland, Ohio, displayed a line of Columbia dry batteries, as well as coils, meters, etc. The line of cells includes the igniter dry cell designed for motor work, multiplex cells and a new reserve dry cell designed as an emergency outfit for touring. M. H. Moffatt, A. E. Carrier and A. C. Henry were in attendance.

C. F. Splitdorf Company, New York, in addition to showing a new magneto, also displayed a number of its coils and timers. The magnetos are made in both the high and low-tension patterns. A new mica spark plug was also shown. In this the shell, mica tube and inner electrode are made conical and forced together under pressure. As an added precaution against short-circuiting an inverted porcelain cup is inserted in the firing cavity. Three styles of timers were on exhibition: the regular timer with plain bearings, a snap point timer with ball bearings and a roller contact type, also fitted with ball bearings. W. J. Hart and F. S. Perrin were in charge of the exhibit.

Société Anonyme Westinghouse, New York, exhibited one limousine bearing the label "This car has traveled more than 8,000 miles without costing one cent for repairs." The car which is a French machine, is fitted with a four-cylinder, four-stroke cycle engine. The gearing is selective, four speeds and reverse, with direct drive on the high-speed and double-chain drive. Forming part of the exhibit was a standard Westinghouse electric traction air compressor driven by an electric motor with an automatic governor. The air was delivered to storage tanks and was used to inflate automobile tires. The complete outfit is intended for garage use. Those in attendance included J. C. McQuistan, C. A. Wombbell, C. D. Brown, A. M. Thackera, M. Coster and J. A. Camprubi.

Industrial and Commercial News

Commercial Intelligence.

THE WEEK IN TRADE.—Retail trade at most points has been stimulated by the colder weather, and the prospect for a good holiday business. In jobbing and wholesale lines, trade is more than ordinarily brisk for December, and business on spring account is all that could be desired at this stage of the season. The car shortage continues, though grain deliveries in the northwest are freer, but on the whole the paucity of railway facilities is seriously affecting many sections, and in consequence supplies of coal are very low at numerous points, while some foundries in the St. Louis and Cleveland districts have been compelled to shut down because of inability to get deliveries of pig iron. Railway earnings for November will show 10 per cent gain. Manufacturers all over the country are busy, the pressure being so great as to cause a considerable number of plants to work both day and night. Labor still continues scarce and additional wage advances are recorded. Money is very high in the cities where the demand is extensive, but most interior towns appear to be plentifully supplied. Collections are good, all things considered, and the situation taken as a whole is very favorable, except in the South Atlantic States, where crop returns have been poor, and in the northwest, where grain deliveries are backward. Supplies of pig iron are smaller than ever. British markets are advancing, and it looks as if Great Britain will not have enough iron to spare for the relief of the United States. Additional sales of foreign foundry iron have been made for domestic account. New business in steel rails is fair, and while demand for structural material is not so active as earlier in the season, some good sized orders are in sight. Copper was firm for prompt and future delivery. Prime Lake, for January, was quoted at 23¼c., and the demand is in excess of the supply. Electrolytic, for January and February, was strong at 22⅝ to 23c. for large tonnages. Casting grades, for delivery in 30 to 60 days, were quoted at 22⅝ to 23c. It is stated that a number of copper and brass working plants in England have shut down because of the scarcity of copper. Stocks of copper and brass manufacturers in Great Britain are reported to be smaller than at any time in 30 years. *Bradstreet's* makes a favorable report as to the business failures during the month of November. The number was 811, as against 805 in October, and 816 in November of last year. With two exceptions this is the smallest number in November for 13 years past. Liabilities for the month decreased 28 per cent from October, but increased 3 per cent over November a year ago. For 11 months the number of failures is the smallest in any year for seven years past, while the liabilities are only a fraction larger than a year ago. The number of failures during the week ending Dec. 6 was 216, against 174 in the previous week, and 203 in the corresponding week of last year.

ELECTRICITY IN STEEL MILL.—The merchant mills of the Illinois Steel Company at Bay View, Milwaukee, have been undergoing extensive alterations and additions during the summer without interfering in any way with the regular operation of the plant, the annual output of which is 300,000 tons. The new facilities are comprised in electrically operated traveling carriers, and rebuilt roll trains, in addition to the compounding of the present mill engines and the placing of orders for an Allis-Chalmers gas engine driven electric generating unit which will operate on blast furnace gas at a very low cost. The works comprise six plants employing altogether from 1,700 to 2,000 men. Each plant consists of a 22-in. rerolling rail mill, a 21-in. bar mill, one 12-in. and two 9-in. mills and an 8-in. merchant mill. Two hundred tons of ore per hour are handled at the ore docks by means of improved hoisting machinery. From the formation of the billet to the finished bar, the progress of the product through the mill is always in one direction, carried to a large extent automatically. The boiler capacity of the plant is furnished by eight 400-hp water tube boilers, in batteries of two. The cooling beds, cranes, transfer table and other electrically-driven appliances about the mills require considerable power. The power house is provided with a capacity of 1,000 kw and two pumping units. With blast furnace gas available, it was decided to install, as an additional unit, a horizontal tandem, double acting Allis-Chalmers gas engine, direct connected to a 500-kw, 240-volt generator of Allis-Chalmers design and built at the company's electrical works in Cincinnati. This unit is to be used for general power service, having sufficient capacity to care for the entire load. It is the first gas-driven unit to be used here, and its application to the Bay View equipment illustrates a peculiar advantage which is inherent in this type of prime mover. For years, the waste gases from the blast furnaces have been burned under the steam boilers, with good economy, as that with the old arrangement the power plant was operated at minimum expense. When the need for additional power became apparent, it was obtained through the compounding of the steam blowing engines now in use instead of putting in extra boilers and steam engines and using coal for fuel. By this plan, a saving of gas is accomplished. If this extra gas were used under a boiler, it would be entirely insufficient for the purpose, but if used in a gas engine it gives a considerable increase in power, due to the higher economy of the gas engine over the combination of steam engine and a gas-fired boiler.

USE OF COPPER.—In a recent article in the American *Review of Reviews*, Mr. C. F. Spears, discussing copper production, says: "With this enormous expansion in production—470 per cent in twenty years—it would seem as though an oversupply of copper is inevitable. As a matter of fact, the American consumers of it are absorbing, month by month, more of the metal than is mined. Old stocks are being called upon to fill the void. It is predicted that, the world over, 1,500,000,000 lb. will be worked up into different shapes in the twelve months ending next December; also that, until 1912, production and consumption will be practically equal, with, perhaps, consumption a little in the lead. For the next twenty years the total use of copper is reckoned at 12,000,000 tons, compared with a total consumption in the last century of 10,000,000 tons. Altogether, the question of the supply of copper for future generations is one of the most interesting in economics. This is an electrical age. Therefore, copper is one of the most accurate barometers of trade. In some respects it is a better gauge of developments in the industrial world than are iron and steel. Between 1895 and 1905 the production of it increased 150 per cent. In the same ten-year period the output of iron and steel rose 145 per cent. Copper, as a medium, is doing in many ways what iron and steel used to do. Its position is somewhat analogous to that of concrete as related to brick. The new form produces the same results as the old, and at a lower rate of cost."

TELEPHONY IN AUSTRALIA.—Bids will be received until January 9, 1907, by the Postmaster-General, Adelaide, Australia, for the following telegraph and telephone material: 10,000 No. 5 porcelain insulators, 5,000 No. 6 porcelain insulators, 2,000 No. 8 porcelain insulators, 10 tons hand-drawn copper wire (100 pounds to the mile), 4 tons phosphor-bronze wire, 5 tons galvanized-iron wire (400 pounds to the mile), 1 ton galvanized-iron tie wire (60 pounds to the mile), 10 miles No. 18 wire insulated with vulcanized india rubber, 5,000 copper tapes for 100-pound wire and No. 6 insulators (to be in bundles of 100 each), 5,000 copper binders for 100-pound wire and No. 6 insulators (to be in bundles of 100 each). Part of order to be placed by Agent-General for South Australia, 1 Crosby Square, E. C., London, England. Bids will also be received until January 14, by the Postmaster-General at Melbourne, Australia, for 9,000 magneto wall telephone sets.

YACHT AND HOUSEBOAT WIRELESS.—Col. R. M. Thompson has arranged to install wireless telegraphy on his yacht and house boat "The Everglades," now laying at Daytona, Fla. The DeForest system will be installed. The electrician and operator with equipment have left New York for Daytona, and "The Everglades" will be in commission December 8. They will cruise during the winter along the Florida, coast reporting whenever desired or feasible.

WESTERN ELECTRIC ACTIVITY.—The increase in the volume of business which the Western Electric Company is turning out is shown by a comparison of the number of its employees at the end of 1905 and at present. December 31 last the company was employing 19,704 men. On November 1 the company had on its payrolls a total of 24,608 hands, an increase of approximately 5,000 or 25 per cent during the ten months.

ROBB-MUMFORD BOILER ORDERS.—The Robb Mumford Boiler Company, South Framingham, Mass., has been awarded the contract for furnishing twenty-four 84-in. x 19-ft. 6-in. horizontal return tubular boilers to be installed at Culebra, Isthmus of Panama, in connection with work which the Isthmanian Canal Commission is doing at that point. It has also secured a contract from the Boston & Albany Railroad lately to build six new locomotive boilers for some of its largest freight engines. It is building three 200 hp boilers of our special internally fired type for the Orleans Ice Manufacturing Company, New Orleans, La. It has recently installed a 150-hp boiler of our internally fired type at the plant of the Ames Shovel & Tool Company, North Easton, Mass., and a 125-hp boiler of the same type at the plant of the Camden Woolen Company, Camden, Me. The last-mentioned installation is the second boiler of the same type at the Camden Woolen Company's plant.

EUREKA (CAL.) DEVELOPMENT.—The Eureka Lighting Company, controlled by C. O. G. Miller, of San Francisco, is remodeling its gas and electric lighting system at Eureka, Cal. An additional 200-hp water tube boiler is being erected, and another 250-hp electric light engine will be installed in Station B, bringing the total capacity of this steam plant up to 1,400 hp. A new gas station, 40 x 65 feet, to be equipped with two gas generating units, with a combined daily capacity of 400,000 cu. ft. of gas, is in plan. It will be erected near Station B and the present gas works will then be abandoned.

ELECTRICS AT PUEBLA, MEX.—Consul-General A. L. M. Gottschalk, of Mexico City, announces the sale of the "City and Industrial Railways" and the "Electric Lighting Company," of the city of Puebla, to a Canadian syndicate recently registered in Mexico with a capital of $6,000,000, United States currency. The Puebla railways were owned by a firm of Wehner, Beit & Co., but the recent death of the head of this firm, Alfred Beit, delayed the transfer from last April until recently. The Light & Power Company is making extensive arrangements for the introduction of water power, which will be taken from the Tuxpango waterfall of the Rio Blanco near Orizaba, where 20,000 horse power are expected to be developed. Within a period of time not yet specified the Canadian company will substitute electric cars in lieu of the present mule tramways. It is said that this will begin to take place in June, although no definite date has been announced. The city of Puebla is also to have a new and complete system of waterworks and sewerage, the work of the Mexican Government. All these enterprises will require machinery and equipment of many kinds.

THE UNION SWITCH & SIGNAL COMPANY, of Swissvale, has just been awarded the entire contract for the interlocking and signaling of the great terminal station now being constructed in Washington, D. C., by the Pennsylvania and the Baltimore & Ohio Railroad companies. The installation will be electro-pneumatic, similar in its general characteristics to that in the railway yards of the Pennsylvania Railroad at the Union Station, Pittsburgh. The Washington installation, however, will be the largest and most complicated signalling and interlocking installation that has ever been constructed in the world. The largest one previous to this was put in service at St. Louis at the beginning of the World's Fair, and before that the most important was the electro-pneumatic interlocking system at the terminals of the Boston South Station. Both of these plants were also installed by the Union Switch & Signal Company.

MOORE LIGHT FOR POST OFFICE.—The Treasury Department of the United States Government contracted recently with the Moore Electrical Company, of Newark, N. J., to light the entire west side of the mezzanine floor of the New York Post Office with the Moore light. This installation will consist of more than a thousand feet of Moore tubing, and is to replace about 525 16-cp incandescent lamps. The tubes will not use more than 20 kilowatts, but, it is asserted, will produce an illuminating effect at least five times greater than the old system of incandescent lamps. The contrast between the efficiency and quality of the Moore light and the Cooper Hewitt mercury tubes on the opposite side of the same floor will also be noted with interest.

BIG WESTINGHOUSE OUTPUT.—The various Westinghouse factories in East Pittsburg have during the last month broken the record in several instances over any previous month. The output and shipments of electrical machinery at the electric works during the month reached the $4,000,000 mark. The Westinghouse Machine Company also received one order which called for $1,250,000.

KERR TURBINE CONTRACT.—The Kerr Turbine Company, Wellsville, N. Y., has secured the contract for the new power plant in the Bennett Building, Fulton street, New York, comprising steam turbine generators of a capacity of 200 kw, made up of two 75-kw Burke generators, direct connected to a 24-in. six-stage Kerr turbine, and one 50-kw Burke generator, direct connected to an 18-in. six-stage Kerr turbine.

BRILLIANT ELECTRIC COMPANY.—There is a rumor afloat that the Brilliant Electric Company, of Cleveland, O., manufacturer of the Brilliant incandescent lamp, contemplates enlarging its plant, owing to the rapid increase of business. It is also understood that it has been figuring on other property on which to erect a new and modern lamp factory, as it has been found to be impossible to take care of the trade with the present equipment, although that plant is one of the best equipped lamp factories in the country. It will be interesting to see what is done.

Financial Intelligence.

THE WEEK IN WALL STREET.—High money rates checked activity on the stock market and produced a heavy tone in prices, notwithstanding the absence of serious liquidation and the continued reports of higher dividends, favorable deals and developments concerning prominent properties. The President's message was well received, and the Street takes a hopeful view of the prospect of currency legislation. The developments of the week were mostly favorable. More or less attention was given to various industrials and specials, among them Colorado Fuel, and United States Steel common has also shown strength, attributed in some quarters to the possibility of a further increase in the quarterly dividend rate next month. One of the leading incidents was the violent break in Nipissing Mines in the curb market. All of the electric securities were weak, and comparatively little business was done in any of them. Without exception, all suffered losses on the week's business. On the curb market a good deal of excitement was exhibited at times as a result of the forced liquidation of mining shares, particularly Nipissing, the Canadian silver property. This latter stock was dealt in to the extent of more than 600,000 shares, or over one-half of the total issue. The closing stock quotation of Dec. 11 are given in the accompanying table:

NEW YORK

	Dec. 4	Dec. 11		Dec. 4	Dec. 11
Allis-Chalmers Co.	17⅜	17⅛	General Electric	177⅜	161⅛
Allis-Chalmers Co. pfd.	45¾	45	Hudson River Tel.	...	...
American Dist. Tel	25	25	Interborough Rap. Tran.	...	...
American Locomotive	75⅛	71⅝	Mackay Cos.	72¾	72¾
American Locomotive pfd.	111	110½	Mackay Cos. pfd.	68¾	68½
American Tel. & Cable	88	87¼	Marconi Tel.	...	...
American Tel & Tel.	...	...	Metropolitan St. Ry.	...	...
Brooklyn Rapid Transit	79⅜	81¼	N. Y. & N. J. Tel.	...	...
Electric Boat	32	27	Western Union Tel.	86¼	86
Electric Boat pfd.	73	70	Westinghouse com.	152	153
Electric Vehicle	...	...	Westinghouse pfd.	...	...
Electric Vehicle pfd	...	...			

BOSTON

	Dec 4	Dec. 11		Dec. 4	Dec. 11
American Tel & Tel.	136⅛	136⅞	Mass. Elec. Ry. pfd	70	69½
Cumberland Telephone	...	...	Mexican Telephone	...	...
Edison Elec. Illum.	275	..	New England Telephone	...	...
General Electric	178	...	Western Tel. & Tel.	...	...
Mass. Elec. Ry.	19¼	20	Western Tel. & Tel. pfd.	79⅛	99

PHILADELPHIA

	Dec. 4	Dec. 11		Dec. 4	Dec. 11
American Railways	51¼	51	Phila. Electric	8¼	9⅛
Elec. Co. of America	11⅜	11⅛	Phila. Rapid Trans	22½	23⅛
Elec. Storage Battery	69	69	Phila. Traction	96¾	...
Elec. Storage Battery pfd.	...	...			

CHICAGO

	Dec. 4	Dec. 11		Dec. 4	Dec. 11
Chicago City Ry.	160	160	National Carbon	85	85
Chicago Edison	...	...	National Carbon pfd.	115	115
Chicago Subway	50	...	Union Traction	...	...
Chicago Tel. Co.	..	115	Union Traction pfd.	...	...
Metropolitan Elev com.	27⅛	28¾			

DIVIDENDS.—The directors of the Interborough Rapid Transit Company have declared the regular quarterly dividend of 2¼ per cent on the capital stock. The dividend is payable January 2. The directors of the Mackay Companies have declared the regular quarterly dividend of 1 per cent on the common and 1 per cent on the preferred stock, payable January 2. The directors of the Tri-State Telephone Company, Minneapolis, have declared the fourteenth regular quarterly dividend, at the rate of 6 per cent per annum. The company under its guarantee will also pay the nineteenth quarterly dividend on the Twin City Telephone Company's stock at the stipulated rate. The Butte Electric & Power Company has declared a dividend of 1¼ per cent on the common stock, payable December 15. Directors of the Electric Boat Company have declared the regular quarterly dividend of 2 per cent on the preferred stock, payable January 2. The directors also declared a dividend of 2 per cent on the com-

mon stock for the year ending December 31, 1906, payable on December 31. The Metropolitan Street Railway Co. will pay the quarterly rental of 1¾ per cent on the stock of the company on January 2, 1907. The directors of the General Electric Co. have declared the regular quarterly dividend of 2 per cent, payable January 15. Directors of J. G. White & Co. have declared a regular quarterly dividend of 1½ per cent on the preferred stock, payable January 2, 1907. The directors of the Boston Suburban Electric Companies have declared a regular quarterly dividend of 75 cents, payable January 15. Directors of the United Traction & Electric Company have declared the regular quarterly dividend of 1¼ per cent, payable January 2. Directors of the Twin City Rapid Transit Co. have declared the regular quarterly dividend of 1¾ per cent on the preferred stock, payable January 2. Directors of the Detroit United Railways have declared the regular quarterly dividend of 1¼ per cent on the capital stock, payable February 1. Directors of the Ingersoll-Rand Co. have declared a semi-annual dividend of 3 per cent on the preferred stock, payable January 1. The directors of the New Orleans Railway & Light Company have declared the regular quarterly dividend of 1¼ per cent on the preferred stock, payable January 15. The directors of the Johnstown (Pa.) Passenger Railway Company have declared the regular quarterly dividend of ¾ per cent, payable December 31.

TELEPHONY IN CHICAGO.—The interests which have recently effected a virtual combination of the independent telephone companies of seven States of the Middle West, and have arranged for the lyaing of the wires of their system in the Chicago subway, are now incorporating in Illinois one of their two projected companies, which together will have a capitalization of about $20,000,000. The Illinois company will probably be known as the Independent Telephone Company of Chicago. Its president is to be Roland R. Conklin, and its vice-president E. L. Barber. Others prominently interested in the enterprise are Martin W. Littleton, John M. Shaw, president of the Atlantic Telephone Company, of New York city; J. D. Powers, of Kentucky, first vice-president of the American Bankers' Association; and Samuel M. Jarvis. Messrs. Conklin and Jarvis were several years ago vice-presidents of the North American Trust Company of New York, leaving that institution on the organization of the National Bank of Cuba in which they were largely interested and which, in 1901, took over the North American Trust Company's business in the island of Cuba. Work will be begun by the Independent Telephone Company as soon as Dr. Louis Duncan, the company's principal engineer, shall have completed his plans for the installation of the cables in the Chicago subway.

BELL TELEPHONE BONDS.—The large amount of new capital needed by the growth of the telephone industry is indicated in the fact that by January 5, 1907, the American Telephone & Telegraph Company will have received four payments of 10 per cent. each on account of the $100,000,000 convertible bonds sold last February, giving it cash receipts of $40,000,000. The fifth installment does not come until three months later, or April 30, when 30 per cent will be paid in. In the fourteen months ending next January the American Telephone Company will have been obliged to put no less than $28,078,000 into the purchase of the stocks of its subsidiary companies. During this period fourteen out of the thirty-three operating companies have issued new stock aggregating $42,824,740, and if the parent company takes its proportion in the ratio of its holdings at the end of the 1905 fiscal year, its cash payments will total $28,078,000. In this same fourteen months' period seventeen of the subcompanies have authorized aggregate increases in their capital stock of $80,809,090, of which only 50 per cent has been issued.

CONNECTICUT TROLLEYS.—The purchase of the Rhode Island Securities Company by the trolley company of the New Haven road took place this week and the plans will put the practical operation of the Connecticut Railway & Lighting Company also in the control of the New Haven road. These two purchases establish the position of the New Haven as one of the greatest trolley companies in the country. It will have a trolley service more than 1,300 miles in length, with a gross business of more than $16,000,000 per annum, all in 5-cent fares. This purchase puts the electric lines of both Rhode Island and Connecticut into the hands of the New Haven road, while the trolley lines in that part of Massachusetts through which the New Haven operates are also in friendly control. The Rhode Island Securities Company is capitalized for $20,000,000 stock, of which $12,000,000 has been issued, and $5,000,000 bonds. Of the $12,000,000 stock $10,000,000 went to the United Gas Improvement Company at the time of the formation of the holding company.

BALTIMORE UNITED.—It is stated from Philadelphia that in accordance with the new financial plan recently adopted the directors of the United Railways & Electric Company of Baltimore will not pay the interest due December 1 on the income bonds or declare any dividend on the preferred stock. The new plan provides that the income bondholders will receive in lieu of cash payments, funding bonds bearing 5 per cent interest for the face value of the interests as it falls due semi-annually up to December 1, 1910, when it is expected that regular cash payments for interest on the income bonds will be resumed. No interest has been paid in cash on the income bonds since the Baltimore fire about three years ago, but the funding bonds provide for interest accumulated to December 1, 1906. There is only a very small amount of preferred stock outstanding on which no dividends have been paid since the fire and no provision is made for them in the plan.

NATIONAL STEEL & WIRE.—The National Steel & Wire Company reports gross sales of controlled companies as follows for the year ending June 30:

	1906.	1905.	Increase	
Safety Ins. Wire & Cable Co.	$2,036,904	$1,368,481	$668,423	48%
Nat. Wire Corp.	1,440,641	1,246,374	194,267	16½%
Nat. St. & Fy. Co.	356,130	158,768	197,362	124%

The National Steel & Wire general balance sheet as of June 30, 1906, follows:

ASSETS.	
Investment in stocks and bonds	$7,177,896
Furniture and fixtures	1,054
Receivables	2,401,394
Cash	45,035
Total	$9,625,379
LIABILITIES.	
Preferred stock	$3,633,700
Common stock	3,875,817
Special loans by directors	1,372,125
Due controlled companies	305,690
Bills payable	286,768
Reserved for unpaid div., May, 1906	56,834
Surplus	94,445
Total	$9,625,379

KANSAS CITY EARNINGS.—The Kansas City Railway & Lighting Company's report for October and five months compares as follows:

	1906	1905	Changes	
Oct. gross	$531,671	$466,860	Inc.	$64,811
Expenses	250,023	210,114	Inc.	39,909
Oct. net	$281,648	$256,746	Inc.	$24,902
Charges and taxes	150,244	139,456	Inc.	10,788
Oct. surplus	$131,404	$117,290	Inc.	$14,114
Five mos. gross	2,406,769	2,164,754	Inc.	242,015
Expenses	1,184,232	1,054,883	Inc.	129,349
Five mos. net	$1,222,537	$1,109,871	Inc.	$112,666
Charges and taxes	724,194	683,160	Inc.	41,034
Five mos. surp.	$498,343	$426,711	Inc.	$71,632

KEYSTONE TELEPHONE EARNINGS.—The Keystone Telephone Company, of Philadelphia, and combined companies, reports for October and four months as follows:

	1906	1905	Changes	
October gross	$80,848	$68,575	Inc.	$12,273
Expenses and taxes	44,741	38,244	Inc.	6,497
October net	$36,107	$30,331	Inc.	$5,776
Four months gross	295,279	264,804	Inc.	10,475
Expenses and taxes	164,037	141,136	Inc.	22,901
Four months net	$131,242	$123,668	Inc.	$7,574

PACIFIC COAST TELEPHONE.—In an official letter from the Southern Pacific States Telephone & Telegraph Company announcement is made to stockholders to the effect that a new company is to be formed to take over the stock of the old corporation. The new company will have a capital of $50,000,000 and will issue bonds to extend the lines now existing and equip new ones. The territory covered by the company's wires embraces California, Oregon, Washington, Nevada and parts of Idaho and Montana.

SOUTHERN PACIFIC STATES TELEPHONE COMPANY.—Announcement is made that a new company is to be formed to take over the stock of the Southern Pacific States Telephone & Telegraph Company. The new concern will have a capital of $50,000,000 and will issue bonds to extend the lines now existing and build new ones. The territory covered by the company's wires embraces California, Oregon, Washington, Nevada and parts of Idaho and Montana.

COLUMBUS EDISON.—The annual meeting of the Columbus Edison Co., Columbus, O., will be held Jan. 15. The directors will declare a quarterly dividend of 1½ per cent on the preferred stock of record of Dec. 22. It will be payable Jan. 1.

GENERAL NEWS.

Construction News.

PRESCOTT, ARIZ.—Ray Hill, Geo. C. Ruffner and others have petitioned the City Council for a franchise to construct an electric light plant. The Council has approved the granting of the franchise and the question will be submitted to a vote of the people on Jan. 8.

DES ARC, ARK.—New machinery has been ordered for the electric light plant owned by the Planters Cotton Oil Company.

ARGENTA, ARK.—The Argenta Light & Power Company, which was recently granted a franchise by the City Council, has purchased a site at Eighth and Main Streets, on which it will build a power plant.

FRESNO, CAL.—The Fresno Traction Company is contemplating extending its line to the boundaries of Yosemite Park.

MERCED, CAL.—It is reported that an election will probably soon be held to vote on issuing $46,000 bonds for an electric light plant.

SACRAMENTO, CAL.—The Board of Trustees has granted to the Northern Electric Company a 50-year franchise to operate an electric road in this city.

RICHMOND, CAL.—The City Council has passed a resolution accepting the bid of W. S. Rheen for a franchise to operate a street railway on Road No. 23.

SAN LUIS OBISPO, CAL.—L. J. Becket has purchased of the Board of Supervisors the franchise to construct and maintain an electric railway in the county of San Luis Obispo for $250.

ONTARIO, CAL.—The San Antonio Heights Electric Railway is to be extended to the new park, which the railway company is laying out on Mountain Avenue. The line is to be built on private right of way.

LAKEPORT, CAL.—E. P. Vandercook has filed a claim in the Recorder's Office at Lakeport, for 30,000 inches of water in Cache Creek, his intention being to build a dam across Cache Creek, and construct a ditch and flume.

PORTERVILLE, CAL.—Arrangements are being made for the construction of the system of the Porterville Gas & Electric Light Company. It is the intention of the company to extend its gas and electric systems to Lindsay for the purpose of lighting and furnishing fuel.

REDLANDS, CAL.—A. G. Hubbard has secured the franchise for a street railway line on Brookside and Citrus avenues from the western to the eastern city limits, a distance of about six miles, for $150. A franchise has also been sold to N. Buckmaster for a street railway from Orange and State streets to the city limits for $450.

GROVELAND, CAL.—The Big Creek Power, Mining, Water & Lumber Company proposes to change its name to the Big Creek Power, Water & Lumber Company. The company plans to erect an electric power plant at a point where 1,950 feet fall and 5,000 inches of water can be had. In addition to this a big sawmill will be erected and also one or possibly two more electric generating plants.

RIVERSIDE, CAL.—The City Trustees have signed a contract with Pacific Light & Power Company and the Edison Electric Company to supply the city with electric energy for ten years. The Edison Electric Company has agreed to take over the municipal plant at Mill Creek Canyon and the transmission line for $12,000. Agreement between the city and the Pacific Light & Power Company provides that the power company will connect the lines of the plant installed by the old Riverside Power Company with lines of the remainder of the system of the Pacific Light & Power Company.

LEADVILLE, COL.—The Leadville Light & Power Company, controlled by Leonard E. Curtis and Henry Hine, of Colorado Springs, Col., has taken over the plant of the Leadville Gas & Electric Company and the Yak Mining & Milling Company.

DENVER, COL.—The promoters of the new electric railway to run from Platte Canon into Englewood, to be known as the Denver & Southeastern, held a meeting in this city, Nov. 24, and elected the following officers: George I. Cole, president; C. H. Chase, vice-president; I. C. Cockey, secretary, and S. B. Thomas, treasurer. The owners of the Platte Canon Fuel & Power Company are behind the scheme. Plans for the erection of a large power house at the mines are nearly completed. This plant will furnish power for operating the road. The road will be about 20 miles in length and will be used for conveying passengers and coal between Platte Canon and Denver.

COLORADO SPRINGS, COL.—John M. Parfet, superintendent of the Ophelia tunnel, through which a number of claims are being worked, has decided on many changes in tunnel operations and a large amount of money will be expended in improvements. A station will be cut at a point one mile from the portal of the tunnel and at the depth of 600 feet underground. As soon as the ground is leveled off, the construction of an electric power and light plant will be started. This plant will furnish electricity for lighting the various properties, being operated through the tunnel and supply power for a ten-drill air compressor which will be installed. When improvements are completed, motors will be used in hauling ore cars in and out of the tunnel.

DANBURY, CONN.—The Danbury & Bethel Gas & Electric Company is contemplating an expenditure of $50,000 in the improvement of its gas and electric plants next year.

NEW HAVEN, CONN.—Application has been made to the City Council by the Consolidated Railway Company for permission to electrify the old Shore Line cut in Fair Haven.

THOMPSONVILLE, CONN.—The consolidation of the Enfield Electric Light & Power Company and the Windsor Locks Electric Light Company took place Dec. 1, and General Manager Parker H. Kemble has announced a change in rates. The rate for electricity has been reduced from 20 cents to 18 cents per kw-hour with 10 per cent. discount if the bill is paid before the 10th of the month. No bill will be rendered for less than $1.00. As a result of the consolidation meter rents have been abolished. The work on the new power station at Windsor Locks is progressing rapidly, and as soon as the new machinery is installed a 24-hour service will be established. The station here is to be closed and electric power will be received from the plant at Windsor Locks. The combined companies will be known as the Northern Connecticut Light & Power Company.

WILMINGTON, DEL.—The Wilmington City Electric Company is installing additional machinery to meet the increased demand for electricity, which is partly due to the demand for electric signs which are being used more than ever before.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Department, Washington, D. C., until Dec. 26, to furnish at the navy yards, etc., Portsmouth, N. H.; Boston, Mass.; Newport, R. I.; New York, N. Y; League Island, Pa.; Annapolis, Md.; Washington, D. C.; Norfolk, Va., and Charleston, S. C., as specified, a quantity of naval supplies, as follows: Schedule 309—Motors, electric grinders, etc. Schedule 311—Electric hoist, etc. Applications for proposals should designate the schedule desired by number. E. B. Rogers, paymaster general.

ST. AUGUSTINE, FLA.—The City Council, on November 28, awarded to the St. Johns Light & Power Company the contract for lighting the city for one year.

JACKSONVILLE, FLA.—An agreement has been reached by the City Council and the Jacksonville Street Car Company, whereby the long expected improvements and extensions of lines will be made.

ATLANTA, GA.—Municipal ownership of the gas and electric light plants is under consideration here.

ROME, GA.—The traction syndicate, composed of Louisville, Ky., capitalists, which recently purchased the Rome street car system, is planning to build an electric railway from this city to Rockmart, a distance of 25 miles, to connect with the Seaboard Air Line.

ROME, GA.—The City Electric Railway of Rome, which succeeded the Rome Street Railway Company, has applied to the Secretary of State for important charter amendments. The name of the company is to be changed to the Rome Railways & Light Company, incorporating a lighting feature, and the capital stock is to be increased to $500,000.

WAYNESBORO, GA.—Bids will be received by the Board of Water & Light Commissioners, at Waynesboro, until December 17, for material and machinery only, for the water and light plant, comprising one 150-hp boiler, one 125-kw alternator, etc., one Corliss engine, tower and tank, hydrants and cast iron pipe. J. B. McCrary & Company, of Atlanta, are the engineers.

ATLANTA, GA.—The Georgia Railway & Electric Company is rebuilding and increasing the capacity of its plants in this city. An addition has been made to the Davis street station of 50 x 100 feet, to provide space for the large gas engine which is to be installed. This unit consists of a 3,000-hp gas engine direct connected to a 2,000-kw, 6,600-volt, 25-cycle, alternating-current generator. The engine was made by the Snow Steam Pumps Works, of Buffalo, N. Y. An extension is being made to the Butler Street Station, to make room for additional boilers. Two 600-hp Babcock & Wilcox water-tube boilers are being installed. The Alabama Street sub-station is being enlarged and practically rebuilt. A new sub-station is being built for the East Point and College Point line, in which a 500-kw, 25-cycle rotary converter will be installed to take care of the present demands. The company is also making many extensions to its underground and overhead lines. The work when completed will cost about $300,000.

PARIS, ILL.—The Paris Traction Company has increased its capital stock from $5,000 to $50,000.

WASHINGTON, ILL.—Geo. W. Myers is reported interested in the construction of an electric light plant.

TAYLORVILLE, ILL.—The Central Light, Heat & Power Company has filed amended articles of incorporation increasing its capital stock from $1,000 to $25,000.

ROCKTON, ILL.—F. M. Coons and Bradner Smith & Company, owners of the Rockton dam, are contemplating raising the dam with a view of generating electricity for commercial purposes, and distributing it to nearby towns.

ELGIN, ILL.—John H. Stickling, of Elgin, of the Elgin Merchants' Power & Light Company, writes that it is proposed to purchase three

producer or oil engines, 125, 250 and 500 hp capacity, respectively, and generators to match, tile for underground cables, wire, and all the necessary accessories, for an electric light plant.

CHICAGO, ILL.—An annex to the present plant of the Chicago Telephone Company at Washington and Franklin Streets, to cost $800,000, is being designed by Pond & Pond, architects. Work on the structure waits on the settlement of the franchise question by the City Council. The building is to contain large storage facilities as well as room for additional equipment.

LITCHFIELD, ILL.—Jacob J. Frey, of the Hillsboro Light & Power Company, and David Davis, of the Litchfield Gas & Electric Company, are forming a syndicate whereby the electric companies of Litchfield, Hillsboro, Raymond and other places will be consolidated. It is said that the McKinley Traction system will be taken into the deal and that a large power plant will be erected in this city.

PITTSBORO, IND.—Olson & Son are planning to install an electric plant in their factory.

INDIANAPOLIS, IND.—The Board of Public Safety has directed that all wires be placed underground in the business section of the city.

NEW CASTLE, IND.—The City Council is reported to have decided to expend about $6,000 in improving the water works and electric light plant.

FLORY, IND.—F. P. Lyons is at the head of a company that has recently purchased the Flora telephone system and proposes to make extensive improvements.

SHELBYVILLE, IND.—The new plant of the Spiegle Furniture Company will be equipped with electrical machinery and operated by electricity. Christian Spiegle is president.

SOUTH BEND, IND.—The South Bend Home Telephone Company contemplates extensive improvements to its system in this city. Theo. Horward is president and manager.

MARION, IND.—The people of this city at a recent election voted for the construction and installation of a commercial lighting plant. The present city plant is inadequate for the demands made upon it.

RISING SUN, IND.—The Ohio River Telephone Company, with principal exchange in this city, has increased its capital stock $75,000 for the purpose of rebuilding the system and installing new equipment.

WEST MONROE, IA.—The citizens have voted in favor of constructing a municipal electric light plant.

LACONIA, IA.—The Laconia Telephone Company contemplates the installation of a new switchboard and other improvements to its system.

MARSHALLTOWN, IA.—Hamilton Browne has acquired an interest in the local street railway system and will extend the line to Haverhill or Ferguson.

FAIRFIELD, IA.—The Iowa & Missouri Traction & Power Company, of this place, will let contracts at once for the construction of its lines from Fairfield to Memphis, Mo., a distance of 52 miles. Harrison Blacklege is president.

MUSCATINE, IA.—Charles Howard, manager of the Muscatine North & South Electric Line, is interested in the construction of an interurban road from Muscatine to Davenport, and electrifying the present road, and the extension of the road from Elrick Junction to Burlington, making a complete electric railway from Davenport to Burlington through Muscatine, for both freight and passenger traffic.

TOPEKA, KAN.—Mayor Davis has received the report of George M. Brill, who was engaged by the Council to investigate the probable cost of rebuilding the city electric light plant according to present needs for lighting the streets. Mr. Brill furnished two estimates, one of the cost of remodeling the present plant and one for entirely rebuilding it. The first and cheaper method will cost $65,000 and the second will foot up a total of $102,500. The first figures include the purchase of 200 open arc lamps and their installation, which item amounts to $30,000. The second plan calls for the purchase of new inclosed arc lamps throughout and consequent engineering work which will cost $49,000 of the $102,000. Mr. Brill states that energy for lighting should either be generated in a modern and efficient plant or it should be purchased from a commercial lighting plant. He advocated disposing of all of the equipment of the present plant for what it will bring and the purchase of an entirely new set of machinery in case the city decides to continue to produce its own electricity for street lighting.

LOUISVILLE, KY.—The Louisville Lighting Company has agreed to replace the present arc lighting system with the new magnetite lamp throughout the city.

LA GRANGE, KY.—The citizens are considering the erection of an electric light plant at a cost of $10,000. For further information address Charles Sauer, president, Commercial Club.

FRANKFORT, KY.—Henry B. Ware, secretary State Board of Capitol Commissioners, writes that the contract for ventilating and heating apparatus, electric wiring, conduit, annunicator and bell service, electric elevators, etc., for the Kentucky State Capitol has been awarded to Joseph McWilliams & Company, of Louisville, for about $76,715.

BRUNSWICK, ME.—A syndicate, represented by Charles Sumner Cook, of Portland, and William M. Pennell, has secured control of the plant and system of the Brunswick Electric Light & Power Company.

AUGUSTA, ME.—John R. Graham, of Bangor, has purchased the Augusta, Winthrop & Gardiner Street Railway, with lines from Augusta to Gardiner, and Augusta to Winthrop, a total trackage of about 14 miles.

BANGOR, ME.—The Bangor Railway Company is contemplating the extension of its line to Frankfort. John R. Graham is general manager. The company announces that final plans for the erection of the Bar Harbor & Union River Power Company's hydro-electric plant at Ellsworth, have been completed and that work will be commenced on the plant in the spring. The plant will be erected on the site of the old Boston Reduction Company with an initial capacity of 2,500 hp. Provision for the extension of the plant up to 20,000 hp will be made. The entire electric and power system of Ellsworth will be rebuilt. A transmission line will be built from Ellsworth to Mt. Desert Island, by means of which electricity will be transmitted to Bar Harbor and the other places on that island.

CUMBERLAND, MD.—The Edison Electric Illuminating Company is making extensive improvements to its system in this city, which, when completed, will cost $50,000. A 750-hp turbo-generator set has recently been installed in the plant. George L. Wellington is president.

CENTREVILLE, MD.—The Queen Anne County Commissioners have granted to the Centreville Electric Light & Power Company the right of franchise to use the county roads, to erect poles, string wires and lay conduits for the purpose of furnishing the farmers in that county with electricity for lighting purposes.

GREENFIELD, MASS.—The Greenfield Electric Light & Power Company is building an addition to its power house in which it will place the transformers to be used in connection with the street railway service.

HOPKINTON, MASS.—Arrangements have been practically completed whereby the Edison Electric Illuminating Company will take over the small electric light plant from the estate of L. E. Coolidge, which has furnished a small number of electric lamps in the town.

SOUTH HADLEY, MASS.—The South Hadley Falls Electric Light Company will install a 650-hp Fitchburg compound steam engine at its plant, together with a 2,000-light dynamo, for use in case of low water or ice in the canal. The engine will be of sufficient power to run the whole plant when necessary.

MIDDLEBORO, MASS.—Work on the new building at the electric station on Wareham street in which the new gas producer plant will be installed is nearly completed. A large dynamo has been installed, and two gas engines are expected in a few weeks. An appropriation of $20,000 was made to make the improvements and additions to the plant.

FLINT, MICH.—The City Council has granted a 30-year franchise to the Detroit, Flint & Saginaw Railway.

IONIA, MICH.—Bids will be received by Gilbert W. Wilson, city clerk, for lighting the streets with electricity for a period of five years.

TRAVERSE, MICH.—W. F. Vieveman has made application to the City Council for a franchise to build and operate an electric street railway in this city.

HOUGHTON, MICH.—The Electric Light Company has petitioned for a franchise to renew its contract with the city, which expired Dec. 1. The Council has directed Mr. Crabbe, electrical engineer of the Quincy Mining Company, to prepare plans for a municipal lighting plant.

GRAND RAPIDS, MICH.—Four electric railways from Grand Rapids to Pontiac and Detroit are to be built during the next 18 months. E. M. Hopkins, president of the four companies, states that negotiations for the construction and equipment of the lines have recently been completed in New York. The lines are to be known as the Grand Rapids and Iona, the Grand Rapids, Belding and Greenville, the Iona and Owosso and Pontiac railways. They are to be built by the W. A. Cullen Company, of New York, N. Y. The capital stock of the four companies is $4,900,000, and bonds are to be issued for $4,250,000. The officers and directors of the road are: E. M. Hopkins, president; J. L. Hudson, vice-president; John T. Rich, treasurer, and Frank Wescott, secretary.

ST. PAUL, MINN.—The plant of the Gorman Electric Company, at 315 Minnesota Street, was destroyed by fire, entailing a loss of $12,000.

VIRGINIA, MINN.—F. B. Meyers, president of the Mesaba Traction Company, has applied to the City Council for a franchise to construct and operate a street railway in this place. Mr. Meyers states that the company will probably build its power house, car barns and shops in the town. The line is to run from Eveleth to Virginia and may extend to Sparta.

JEFFERSON CITY, MO.—Warden Hall, of the Missouri penitentiary, will ask the Legislature for an appropriation of $150,000 for the purpose of building a new power plant. Plans have been drawn for a new central plant to supply light, heat and power to all the penitentiary buildings.

McCOOL JUNCTION, NEB.—S. Burnham has ordered machinery for an electric light plant.

OMAHA, NEB.—Contracts have been placed by the Omaha & Council Bluffs Street Railway Company for a 2,000-kw dynamo and engine; also for the construction of the necessary sub-stations north and south and at Lake Manawa. The company will expend more than $200,000 in improving its system, and is also contemplating further extensions to its lines.

YERRINGTON, NEV.—The Nevada, Mason & Los Angeles Railway Company has been formed with a capital stock of $1,000,000, for the purpose of constructing an electric railroad from Wellington to Wabuska. Electricity for operating the new road will be furnished by the Truckee River General Electric Company. The officers of the company are Newton Evans, of Los Angeles, Cal., president; J. I. Wilson, vice-president; E. W. Fairbanks, secretary, and J. G. Kaufman, treasurer.

NORTH SALEM, N. H.—The Thomas Duston mills have been sold to a syndicate consisting of L. W. Taylor and others for an electric light plant.

ALBUQUERQUE, N. M.—The Automatic Telephone Company which was sold under a foreclosure sale, has been purchased by the Colorado Telephone Company, and the two plants will be consolidated.

ARTESIA, NEW MEX.—A company of New Mexico and Missouri capitalists is being organized to install a large hydro-electric plant on the Penasco River at a point about fifty miles west of Artesia. Among those who are interested in the project are J. B. Quigley, of St. Louis, Mo.; A. L. Ross, of Versailles, Mo., and D. M. Ross, of Artesia. It is estimated that the proposed plant will cost about $250,000. Transmission lines will be built to Artesia, Roswell, Carlsbad, Hagerman, Lakewood and a number of other towns of the Pecos River valley.

TROY, N. Y.—The United Traction Company will soon make an application for a franchise to construct a line along Pawling Avenue to Albia.

ROCHESTER, N. Y.—The Rochester Railway Company has petitioned the City Council for franchises for the construction of lines through various streets in the city.

NEW ROCHELLE, N. Y.—The Common Council has granted a franchise to the New York, Westchester & Boston Railway Company to construct its lines in New Rochelle.

RAVENNA, N. Y.—The West Shore Electric Company, which was organized recently, has been granted a 5-year franchise. The company will erect a power house to supply electricity for light and power purposes both to this city and Coeymans.

YONKERS, N. Y.—Mayor Coyne, in a message to the Council, recommends the construction of a municipal lighting plant. The members of the Common Council expressed their approval of the proposed improvements when the message was read.

CANASTOTA, N. Y.—The Central New York Power Company has purchased a plot on East North Canal street on which it will erect an electric plant. The company was recently awarded a contract for furnishing electric light in this village.

OSWEGO, N. Y.—The Oswego Street Railroad Company has been purchased by the Beebe syndicate for about $250,000. The new owners have already let contracts and started work on the extension of the Syracuse, Lakeshore & Northern Railway from Long Branch to Fulton.

NEW YORK, N. Y.—Bids will be received by John V. Coggey, Commissioner of Correction, until December 18, for furnishing all labor and material required to run a new electric power cable and to install electric motors in work shops on Blackwell's Island, N. Y., connected with the New York penitentiary.

SYRACUSE, N. Y.—The Syracuse Rapid Transit Railway Company has secured franchises to construct a double track along the turnpike to Hoppers Glen, and from the city line at Cortland Street to the Seneca Turnpike. The improvements will be started early in the spring and will cost more than $100,000.

ALBANY, N. Y.—The capitalists who have secured the control of the Troy, Rensselaer & Pittsfield Railroad will begin at once the construction of an electric road from Rensselaer to Troy, and another line from some point along the Albany & Hudson Railroad, to connect with the Pittsfield railway system. Allen W. Paige is president of the company.

ALBANY, N. Y.—The new electric lighting plant at the Capitol will be in complete operation within two weeks. Thereafter the Capitol and the Executive Mansion will be lighted with electricity furnished by this plant. The plant consists of three engines and three dynamos. The plant has been installed under an appropriation of $60,000 made some time ago.

CONCORD, N. C.—A franchise has been granted to the Concord Reality Railway Company to build a street railway in this city. C. W. Johnson is president.

CHARLOTTE, N. C.—The Southern Power Company will expend about $3,000,000 in improvements. It will also extend its system to Statesville. W. S. Lee, Jr., is engineer.

HIGH POINT, N. C.—It has been decided to erect a municipal lighting plant for the town. A committee has been appointed to secure a site and purchase machinery for the plant.

WILSON, N. C.—Application has been made by out-of-town capital to the county and town commissioners here for a franchise to operate electric car lines over the county roads and town streets.

FAYETTEVILLE, N. C.—The Cape Fear Company, of which Eugene Maxwell is manager, is considering enlarging its plant, which is estimated at 4,000 hp, by the development of other water powers.

GILKEY, N. C.—J. A. Glenn and associates have purchased a water-power site near here and will erect a hydro-electric plant to operate their mills, and will also furnish electricity to others who wish it.

RALEIGH, N. C.—An appropriation will be asked of the next State Legislature for an electric plant for the College of Agriculture and Mechanical Arts, at Raleigh, to furnish light, heat and power for the college buildings.

SANFORD, N. C.—The Cape Fear Electric Power Company, of Fayetteville, secured a franchise to furnish light and power to Sanford. The company will probably develop much more power at the plant at Buckhorn. R. P. Gray, of Fayetteville, is secretary.

FAYETTEVILLE, N. C.—The Carolina Telephone & Telegraph Company has been granted a franchise in the city. The company contemplates the rebuilding of the local exchange and improvements to its system involving an expenditure of between $20,000 and $30,000. George A. Holdemess is president.

ROANOKE RAPIDS, N. C.—The Roanoke Rapids Power Company is to construct a hydraulic power plant at Roanoke Rapids, N. C. A 2,000-ft. dam will be constructed across the Roanoke River and a power house will be erected in which machinery for developing 1,000 hp will be installed at first. Additional units will be installed later. W. M. Habliston, president of the National Bank of Virginia, Richmond, is president of the enterprise.

YOUNGSTOWN, OHIO.—Surveys are being made under the direction of Richard W. Randolph, of Pittsburg, Pa., for the Yonugstown & Ohio River Railroad Company for a new route from West Point to the river.

CHICAGO JUNCTION, OHIO.—A company is being formed to build an electric railway between Bucyrus, New Washington and Chicago Junction. W. K. Southaid can furnish information pertaining to the project.

EATON, OHIO.—The City Council is negotiating for the purchase of the Eaton Commercial Lighting plant and operating it under municipal ownership. If the city secures the plant new machinery and equipment will be installed.

WESTERVILLE, OHIO.—L. H. McFadden, clerk of the Board of Public Affairs, writes that the Electric Supply & Construction Company, of Columbus, has secured the contract for engine, generator and switchboard for the electric light plant for $5,280.

CLEVELAND, OHIO.—The City Council has passed an ordinance authorizing the board of public service to receive bids for lighting the streets next year. The board was also empowered to spend $6,500 on the small municipal plant owned by the city.

BRYAN, OHIO.—A resolution has been adopted by the City Council providing for a special election on Dec. 27 to vote upon the question of issuing $40,000 in bonds, for the improvement of the municipal light and water plant. If the people consent, the board will equip the plant will new electrical machinery and oil engines.

TOLEDO, OHIO.—The Toledo Railways & Light Company is contemplating the erection of a sub-station at a cost of $30,000 on its property on Central Avenue, to furnish electricity for light and power that will be required by the proposed new White City on Auburn Avenue, and also to take care of the lighting business in that portion of the city.

LAKEWOOD, OHIO.—The village council, at a meeting a few days ago, again took up the question of issuing bonds for the improvement and enlargement of the municipal lighting plant, but the result was a tie. A vote on selling the plant to the Cleveland Electric Illuminating Company resulted the same way and all action now seems to be blocked.

COLUMBUS, OHIO.—According to the investigations of the State Commission appointed to install a lighting plant in the State House, the $25,000 appropriated will not be sufficient. The engineers estimate that $15,000 will be required to put the wiring of the building in good condition, and that $10,000 would be insufficient to secure an adequate plant for the lighting that is required in the building. Bids will be received up to Dec. 10 for lighting the buildings for the next two years, and upon the figures submitted will depend the decision of the commission as to whether a private plant is advisable.

IONE, ORE.—The citizens have voted in favor of issuing $4,000 in bonds to establish an electric light plant to be operated by steam power.

GOLD BEACH, ORE.—T. M. Keyser has secured water rights on Hunters Creek, for the purpose of installing a power plant, to be used in smelting and refining the precious metals in the beach sands of Gold Beach. The plant will be located about six miles up Hunters Creek at what is known as Little Canyon.

DALLAS, ORE.—The new electric plant of the Willamette Valley Company has been completed and is now in operation. The company now furnishes electricity for lighting and power in Dallas, Monmouth and Independence, and is negotiating with several towns north of Dallas to furnish lighting and power. Many of the manufacturers are changing from steam and gasoline to electric power.

ROSEBURG, ORE.—The Roseburg water and light systems have been sold to A. Welch, to whom the City Council has granted a franchise. It is reported that Mr. Welch represents the firm of Rhoades, Sinkler & Butcher, of Philadelphia, Pa. The new owners are planning improvements and additions to the plant which will include a 1,000,000-gallon pump, a 5-mile pipe line between Winchester and Roseburg, and the raising of the Winchester dam five feet.

SHAMOKIN, PA.—M. H. Kulp, it is said, is preparing to establish a lighting system in Edgewood suburb.

YORKVILLE, PA.—The Borough of Yorkville has entered into a contract with the Edison Electric Illuminating Company, of Pottsville, for a term of five years for lighting the streets of the borough. The company is to furnish 14 or more magnetite arc lamps.

WICKSBORO, PA.—The question of lighting the streets by electricity is now under consideration. Negotiations are in progress with one of the electric light companies and the Borough Council, and it is expected that a contract may be closed soon.

PHOENIXVILLE, PA.—Dr. Charles H. Detwiler, of Royersford, is interested in the promotion of a company to build an electric railway from Pottstown to Bridgeport, following the Schuylkill River, and which will pass through Spring City, Phoenixville and Valley Forge.

PHILADELPHIA, PA.—Extensive improvements are to be made to the electric railway of the West Jersey & Seashore Railroad, at a cost of $500,000. The directors have authorized the purchase of 32 new cars. The capacity of the Westville power station will be greatly increased to provide power for increase of traffic during the summer months.

CHAMBERSBURG, PA.—An application will be made on Dec. 27 to the Governor by M. C. Kennedy, H. A. Riddle, C. M. Davidson, Thomas D. Kennedy, Thomas J. Brereton, and J. H. Tonge for a charter for an incorporation to be called the Caledonia Street Railway Company. It will run to Gettysburg from Caledonia, a distance of about 13 miles.

KITTANNING, PA.—Extensive additions and improvments are being made to the power plant of the Kittanning & Leechburg Railways Company at Garrett's Run. A 250-kw direct-current generator, an alternating-current dynamo of 375-kw capacity, and a motor generator set of 375-hp are now being placed in the plant. A new 600-hp engine will be installed in the power house in January or February. The generator was made by the Burke Electrical Company, of Erie.

WESTERLY, R. I.—The Norwich & Westerly Railway Company has secured a right of way for the construction of its line to Pleasant View and to Weekapaug.

BRISTOL, R. I.—The Town Council has made arrangements with the Bristol County Gas & Electric Company, whereby the street lamps, both arc and incandescent, will remain lighted until 1 o'clock a. m. each night, instead of being put out at 12:30 a. m. The extra cost of the new plan will be between $600 and $700 per year.

AIKEN, S. C.—Edgar Pilcher, representing the Augusta-Aiken Electric Road, states that all the rights of way have been secured from the Edisto River to Columbia, and that he is now securing the rights from the Edisto to Aiken. It is expected that the road will be built in the near future.

CHARLESTON, S. C.—The Charleston Consolidated Railway, Gas & Electric Company have notified the special committee appointed by the City Council to confer with the company in regard to securing reduction in the price of gas and electricity, that the following rates will be charged for electricity, to take effect March 1, 1907. The rate is 15 cents per kw-hour, the minimum charge to be $2.99; from $3 to $20, 15 cents per kw-hour, discount for payment before the 10th of each month, 10 per cent; from $21 to $40, 15 cents per kw-hour, discount for payment before the 10th of each month, 20 per cent.; over $41, price 15 cents per kw-hour, discount for payment before the 10th of each month, 33⅓ per cent; window display lighting, 15 cents per kw-hour, discount for payment before the 10th of each month, 33⅓ per cent; window display lighting in connection with approved electric sign, price 15 cents per kw-hour, discount for payment before the 10th of each month, 50 per cent.

PIERRE, S. D.—The City Council has signed a contract with the Westinghouse Electric & Manufacturing Company for an electric lighting plant to be installed in this city.

CHATTANOOGA, TENN.—The Chattanooga Railways Company has decided to enlarge the Ridgedale power house and furnish electricity for operating its street railway system. The contract has been awarded to the West Construction Company for the erection of a large addition to the power house building. The company has ordered two 800-kw generators and the plant when completed will have a capacity of 2,600 kw. The Chattanooga Electric Company is now furnishing electricity for operating the street railway system.

ENNIS, TEX.—A franchise has been granted by the City Council to the Central Texas Traction Company, to build its interurban electric railway in the city streets.

BROWNSVILLE, TEX.—F. Champion, city secretary, writes that it is proposed to construct water works and an electric light plant, at a cost of $75,000. W. M. Ratcliffe is engineer.

WEATHERFORD, TEX.—The Water, Light & Ice Company has recently installed in its plant a new 150-hp engine and an alternating-current Bullock generator of 100 kw capacity. The company intends to change its entire system from direct to alternating current during the coming year. W. F. Altfather is manager.

PALESTINE, TEX.—Jas. F. Brook, consulting engineer, Palestine Electric Light Company, writes that the Westinghouse Electric Company has secured the contract for turbo-generators and other electric equipment for the proposed electric light plant for $28,000. The Sterling Boiler Company secured the contract for boilers, concrete stack and steam main all connected, for $10,500. The contracts for the cooling tower, condenser and pumps have not yet been let.

SALT LAKE CITY, UTAH.—The Utah Light & Railways Company is making plans for extensive improvements in its street railway system and electric lighting and power plants, at a cost of over $2,000,000.

LUDLOW, VT.—Preparations are being made for the installation of the generator in the municipal electric light station which will double the capacity of the plant.

DANVILLE, VA.—The city is now agitating the question of municipal ownership of the lighting plants.

BUCHANAN, VA.—The James River Water Power Company, of Buchanan, has been granted a charter to construct water and electric power plants. O. C. Huffman is president.

NORFOLK, VA.—A permit has been granted the Norfolk & Portsmouth Traction Company for the erection of boilers in its new power house at the foot of Reeves Street.

RADFORD, VA.—The re-organization of the Radford Water Power Company has been perfected, and the following officers have been elected: J. L. Vaughan, president; J. A. Baird, secretary; W. W. Carr, treasurer; J. R. Vaughan, general manager. Th power will be improved and new cars purchased in the near future. In the early spring the car line will be extended from First to Eighth Streets, going by way of the fair grounds.

FAIRFIELD, WASH.—An effort is being made to form a stock company to install an electric light plant here.

SEATTLE, WASH.—The extension of the Rainer Heights line is being contemplated by the Seattle Electric Company.

SPOKANE, WASH.—The Interstate Telephone Company has filed with the County Auditor notice of an increase in its capital stock from $100,000 to $500,000.

GEORGETOWN, WASH.—The Seattle Electric Company of Seattle, has secured a franchise to build an electric power plant in this city. H. F. Grant is manager.

WENATCHEE, WASH.—The Wenatchee Electric Company is contemplating extensive improvements and greatly increasing the capacity of its plant during the coming year.

SEDRO WOOLEY, WASH.—A corporation is being formed for the purpose of building an electric railway from this city to La Conner. A. W. Lynn, of San Francisco, is interested in the project. The principal place of business will be at Sedro Wooley.

CONCONCULLY, WASH.—A. M. Dewey, of Spokane, has applied to the County Commissioners for rights of way over certain highways of the county for an electric railway, which is to run from Nighthawk to Brewster, a distance of 80 miles. Power for the proposed lines is to be developed on the Sinlebeltin River, where Mr. Dewey and his associates own water rights, from which 20,000 hp can be developed.

TACOMA, WASH.—Water rights for a power plant on the Puyallup River have been filed upon by City Electrician A. L. Thorn and G. B. Fairbanks. Mr. Fairbanks is western manager for the Westinghouse Electric Company. The rights have been filed with the intention of turning them over to the city providing it decides to utilize water power to generate electricity. The cost of the proposed plant will be in the neighborhood of $700,000.

TACOMA, WASH.—C. A. Timblin, a representative of the Westinghouse Electric & Manufacturing Company, has filed on 150,000,000 cubic feet of water of Lake Kapowsin for the purpose of utilizing power for manufacturing purposes in Tacoma and Seattle. Mr. Timblin states that he intends to get this vast quantity by raising the water in the lake from eight to fifteen feet by dams, placed across its outlet, where he has posted notices of intention. It is believed that the Westinghouse Company intends to enter this field with power-generating plants. It offers to build and equip a power plant for the City of Tacoma for about $500,000. Tacoma owns its lighting system, but buys its power.

MEDFORD, WIS.—The Medford Light & Heating Company has increased its capital and intends making improvements. F. S. James is manager.

CEDARBURG, WIS.—The Milwaukee Northern Electric Railway Company is contemplating the erection of a power house and car barns at this place in the near future.

SUPERIOR, WIS.—It is stated that the Superior Water, Light & Power Company intends making improvements and has increased its capital for this purpose. A. L. Rhodes is chief engineer.

HARTFORD, WIS.—The Milwaukee Electric Railway & Light Company is surveying a route for an electric railway from North Milwaukee to Fox Lake, via Holly Hill, Menominee Falls, Lake Five and Beaver Dam will be reached by the extension.

MANAWA, WIS.—The water power, mill building and about twenty acres of land on the Little Wolff River have been purchased by the Allen's B. B. B. Flour Company, of San Jose, Cal. It is the intention of the company to build an electric railway from the mills to Manawa, a distance of three miles, and operate it with the power at Little Wolff. Ultimately the line will be extended to New London and Weyauwega.

GRAND FORKS, B. C.—L. Campbell, manager of the West Kooteney Power Company, has purchased the Top Ranch, situated about 1½ miles from the city, on which he will install an electric pump for irrigation purposes in the spring.

VANCOUVER, B. C.—Application will be made to Parliament at the next session by the Burrard-Westminster Boundary Railway & Navigation Company for power to construct and operate an electric railway in the southeastern part of the city, Hastings and intervening towns to Port Moody. Tupper and Griffin are agents for the promoters.

CALGARY, CAN.—W. M. Alexander, Brandon, Man., has made a proposition to the city to build and equip an electric light plant, also an electric street railway. Mr. Alexander is supported by a syndicate which is willing to spend $500,000 on the works if a satisfactory arrangement can be made with the city. Address Mayor Davidson.

GLENBORO, MAN.—The Council is considering a proposition to install an electric lighting plant.

BIRTLE, MAN.—Jas. M. Hough, city clerk, writes that the construction of an electric light plant has been suggested, but nothing definite has yet been done.

WINNIPEG, MAN.—The City Council is taking steps to frame a by-law to compel all electric light and power wires and telegraph and telephone wires on Main Street to be placed underground.

FREDERICTON, N. B.—A syndicate composed of James Burgess, J. A. Tweedie and John Stewart has been formed for the purpose of building an electric street railway from St. John to Grand Falls, a distance of 124 miles.

HAMILTON, ONT.—The fire, water and light committee will soon call for tenders for two electric pumps for the waterworks, to cost $50,000.

FORT FRANCIS, ONT.—The Council has decided to reject all tenders for the municipal electric lighting plant, having decided not to install a plant this year.

GALT, ONT.—The Hydro-Electric Power Commission has notified Town Clerk McCartney that the maximum price named for 2,500 hp will be $22 per hp per year, delivered to the border of the town.

ONTARIO, ONT.—The Board of Public Works has decided to make application to the Ontario Hydro-Electric Commission for 15,000 hp. It is estimated that the cost will be about $14 per hp per year for a 24-hour service.

WINDSOR, ONT.—On the recommendation of the Light Committee, the City Council, December 3, decided to employ an expert to estimate the probable cost of a new electric light plant which it is proposed to install.

OTTAWA, ONT.—The Canadian Pacific Railway Company has purchased at public auction the Capital Power Company, of Deschenes, Que., for $240,000, and will probably electrify the Pontiac Junction Pacific Railroad.

KINGSTON, ONT.—The Hydro-Power Commission, Toronto, states that power can be delivered in Kingston at a figure not more than $23.50 per hp per year for 2,500 hp per 24 hours per day. The power will be developed at Trent River. If 4,000 or 5,000 hp were used the price would be lower. This power can be delivered within a year.

MONTREAL, QUE.—At a meeting of the City Council, held Nov. 26, two new proposals were submitted to the City Council for furnishing electricity for light and power in the city of Montreal. The Central Heat, Light & Power Company, which is now furnishing electricity for light, heat and power in the city, requests the privilege to continue its business and offers to pay the city 4 per cent of its gross earnings. The St. Louis Light & Power Company also applied for permission for use of the streets for the purpose of transmitting electricity or conveying gas to the citizens of Montreal. The company, which is controlled by representative business men of this city, has made arrangements with J. J. Westgate, owner of Isle Heron, and of the water power adjacent thereto in the Lachine Rapids, thus securing for the company this water power. The company offers to pay a reasonable proportion of its earnings to the city or to transfer 25 per cent of its capital stock to the city. In case the permission is granted the company will at once begin operations for the development of power and will be ready to supply electricity for light and power in Montreal within two years and six months.

TORREON, MEX.—The plant of the Lerdo & Torreon Electric Light & Power Company at Torreon is being enlarged and improved.

CHIHUAHUA, MEX.—A. C. Nash, general manager of the street railway system in Chihuahua, has obtained a concession from the state and municipal governments for the construction of a complete system of electric street railways in the city.

MEXICO CITY, MEX.—The Federal Government has granted to the Inde Gold Mining Company a concession for the installation and operation of a hydro-electric plant on the Sestine River in the state of Durango. A large dam will be built across the Sestine River, near the town of Inde, to supply the initial power. H. D. Crowder, superintendent of the Inde Gold Mining Company, will be in charge of the installation work.

PUEBLA, MEX.—The Puebla Tramways, Light & Power Company will soon begin the work of electrifying the existing street railway system of Puebla. This company is also preparing to install a hydro-electric plant at the Tuxpango water falls on the Rio Blanco, near Orizaba. It is planned to develop 20,000 horse-power which will be transmitted to Puebla, Orizaba and other cities. The electric lighting plant in Puebla, which the company purchased, will also be enlarged and improved. The company has a capital stock of $6,000,000.

Company Elections.

FOND DU LAC, WIS.—At a meeting of the Fox River Valley Railway Company, held recently, the following officers were elected: Dr. G. Brickbauer, of Chilton, president; F. Phillips, of Fond du Lac, vice-president; R. H. Crosby, of Fond du Lac, secretary; A. J. Pullen, North Fond du Lac, treasurer; J. M. Seamon, of Fond du Lac, general manager. The company will operate a line from Cedarburg to Appleton, with a branch to Chilton.

New Industrial Companies.

THE JONES & GROSS ELECTRICAL COMPANY, of New York, N. Y., has been incorporated with a capital of $6,000. The directors are J. Jones, J. Jones, Jr., and H. Gross.

THE AUSTIN ENGINE COMPANY, of Brooklyn, N. Y., has been incorporated with a capital stock of $25,000. The directors are W. K. Austin, James Brown and Joseph McGuinness.

THE TENNY INGRAHAM COMPANY, of Chicago, Ill., has been incorporated with a capital stock of $10,000 for the purpose of manufacturing electrical supplies, etc., by Wallace A. Walker, and others.

THE STANDARD ELECTRIC STORAGE BATTERY COMPANY, of Chicago, Ill., has filed articles of incorporation with the Secretary of State, with a capital stock of $15,000, for the purpose of manufacturing electric supplies. The incorporators are A. C. Torbett, Louis E. Otto and A. W. Underwood.

Legal.

DAMAGES FOR DEATH RESULTING FROM CONTACT WITH LIVE WIRE.—In an action to recover damages for the death of a parent, resulting from his taking hold of an electric cord carrying a dangerous current by reason of its being crossed with other wires, the jury, in fixing damages, may take into consideration the loss of instruction and moral training to the minor children by reason of the death of their father where the evidence tends to show such loss. Goddard vs. Enzler, Supreme Court of Illinois.

CUTTING SHADE TREES IN ERECTION OF TELEPHONE LINE.—A telephone company has no right to cut a shade tree not belonging to it for the purpose of erecting a telephone line unless there exists a necessity for the act, and in the absence of evidence of such necessity the presumption is that the cutting was unlawful. In a case where the cutting has been unlawfully done the owner of the tree may recover from the telephone company without showing negligence on the part of the company. Betz vs. Kansas City Home Telephone Company, Kansas City (Mo.) Court of Appeals.

McCALL FERRY LITIGATION.—Counsel for the McCall Ferry Power Company and the Susquehanna Canal and Power Company filed a demurrer in the Dauphin County Court, Pennsylvania, to the proceedings instituted by Attorney General Carson recently to show cause why these companies should not be dispossessed of their charters because of an alleged illegal combination. The defendant companies deny the allegations set forth in the bill in equity filed by the Attorney General and ask that it be dismissed and the State directed to pay the costs. The court has not yet fixed a date to hear the case.

LIABILITY OF TELEGRAPH COMPANY FOR FAILURE TO DELIVER MESSAGE PROMPTLY.—In accepting a message for transmission a telegraph company contracts to deliver promptly, and in an action for damages resulting from a failure to make a prompt delivery of a telegram it is no defense that the agent of the company had other duties to attend to in his capacity as agent for another company. In such a case the company is negligent if it does not have sufficient employees to do the work it contracts to do and is chartered and paid to do. Mott vs. Western Union Telegraph Company, Supreme Court of North Carolina.

STOPPING DAM CONSTRUCTION.—John M. Williams, of New York, has obtained a temporary injunction restraining the Westinghouse-Church-Kerr Company, of New York, from building a dam on Mianus River, just north of the Boston Post Road. The plaintiff owns five and one-half acres of land on the west side of the river, which he claims is an estuary of Long Island Sound. The defendant is constructing the dam for the New York, New Haven & Hartford Railroad, the object being to obtain a water supply for the big power house. The same firm is building further to the south, where the river empties into the Sound. Work had begun on the dam and a force of about two hundred men were building it when Deputy Sheriff Hendrie served the papers.

INJUNCTION RESTRAINING INTERFERENCE WITH TELEPHONE LINE.—Th defendant, claiming to have an interest in a telephone line controlled by the Western Union Telegraph Company, connected a line upon which he had a telephone with the company's line, which act resulted in impairing the communication on the latter line. The company severed the connectionq but the defendant persisted in restoring it and the company was finally compelled to petition for an injunction to restrain the defendant from renewing the connection. It was held that whether the defendant had any interest in the company's line was immaterial and that the company was entitled to an injunction enjoining the continued attachment of the wires. If the defendant had any rights in the company's line his only redress rested in enforcing his rights in a peaceable manner through the courts. Western Union Telegraph Company vs. Ulrich, Kansas City (Mo.) Court of Appeals.

ENAMELING PATENTS VOID.—Judge Holt, in the United States Circuit Court of Appeals, has handed down a decision reversing the finding of the court below sustaining the patents involved in the suit of the National Enameling and Stamping Company and Lalance & Grosjean Manufacturing Company, as plaintiffs, against the New England Enameling Company. Judge Wallace also wrote a concurring opinion, in which he expressed himself as against the strict interpretation of patent specifications tending to grant what would practically be a monopoly of important industries. "The evidence shows," writes Judge Holt, "that all enamelers are constantly trying new formulas, and that a few succeed while most fail. Why some succeed and others fail no one knows. All the experts agree that in the present state of chemical science it is impossible to state what chemical action takes place when glass is produced by the fusion of sand and certain fluxing substances. All that is known is that the ingredients are fused and glass results."

LIABILITY OF TELEPHONE COMPANY FOR INJURIES TO CHILD FROM MACHINE LEFT IN HIGHWAY.—In an action for damages brought against a telephone company, it appeared that the employes of the company, at the time of the accident for which damages

were claimed, were engaged in placing a telephone cable in position. A part of the apparatus used in the work consisted of a snatch block, fastened to a post at a point near the ground. In the center of the snatch block was a pulley, through which was run a rope attached at one end to the cable and at the other to a team of horses. While the work was in progress the snatch block was left entirely unguarded. The plaintiff, a boy, seven years old, placed his hands upon the rope while the team was standing still, and, upon the sudden starting of the team, his hands were drawn down into the snatch block and crushed. The company was held responsible in damages for the injuries. It was held that, while the plaintiff's placing his hands upon the rope was technically a trespass, he was not precluded from recovering damages upon that ground. O'Leary vs. Michigan State Telephone Company, Supreme Court of Michigan.

ADMISSIBILITY OF EVIDENCE IN ACTION FOR DAMAGES FOR DEATH CAUSED BY NEGLIGENCE.—An employee of the defendant, working in the capacity of a plumber, while engaged in the work of joining two pieces of pipe at the top of a water tankhouse owned by the defendant, came in contact with a wire, owned and controlled by the defendant, carrying a high potential current of sixteen thousand volts, and was killed. At the time of his death, the deceased was working on a platform beneath the heavily charged wire and came in contact with it in attempting to stand erect and, at the same time, to bend forward and look down at a fellow workman on the ground below. The defendant was charged with negligence on the ground that the place provided for the deceased to work in was one of danger and that he did not know the nature or properties of electricity, nor the dangers incident to coming in close proximity to electric wires. On the trial the deceased's mother testified that he had no knowledge of electricity, it being material under the issues to ascertain whether the deceased understood the dangers arising from the use of electricity on wires. The mother's only reason for making the statement was that if her son had learned of electricity and its dangers he would have spoken to her of it and that he had never mentioned any such matter to her. This testimony was objected to and it was held on appeal that it was inadmissible. Ordinarily one person cannot know what is in the mind of another, and direct testimony by a witness that another knows or does not know a particular fact is, for that reason, in most cases improper. The testimony was also inadmissible under Sec. 1845, California Code of Civil Procedure, requiring witnesses to have knowledge of facts testified to, except in certain named cases. Sneed vs. Marysville Gas & Electric Company, Supreme Court of California.

DEATH BY CONTACT; LIABILITY; EXPERT TESTIMONY.—In an action to recover damages for the death of one of the defendants' employes it appeared that the defendants were operating an electric light plant and a street railway system. The deceased, while in the performance of his duties in the defendants' car barn, was killed as the result of grasping an electric cord attached to an incandescent lamp at a point where the insulation had become worn and defective. It was established that the wires carrying harmless currents for lighting purposes, known as "secondary wires," had become crossed with "primary wires" transmitting two thousand or more volts of electricity. It also appeared that, during the day upon which the accident occurred, three other persons had been rendered unconscious by shocks received from the secondary wires, which ordinarily carried a current of only one hundred and four volts, and that this information had been telephoned in to the defendants' office. The evidence was considered sufficient to sustain a finding that the defendants had notice of the fact that a dangerous current was being transmitted over the secondary wires in time to have warned their employe and that they were liable in damages for his death. An expert electrician was permitted to testify, in answer to a hypothetical question, as to how, in his opinion, the shock might have been received. It was objected that this question called for the opinion of the expert upon the very question which was to be decided by the jury. The court said, in answer to the objection, that, from the nature of expert testimony, every hypothetical question propounded to an expert calls for an opinion upon some issue or fact to be determined by the jury and that the objection advanced is, for that reason, not always valid. The opinion of an expert is admitted in any case only from necessity, where some knowledge, not possessed by persons in general, is required in reaching a proper conclusion from a given state of facts and its admission is in no wise an invasion of the functions of the jury. It is the province of the jury to determine whether the state of facts, assumed by the expert to be true, has been established by the evidence.—Goddard vs. Enzler, Supreme Court of Illinois.

Obituary.

PROF. F. TOWNSEND.—Prof. Fitzhugh Townsend, A. B., E. E., instructor in electrical engineering at Columbia University, died of typhoid fever on December 11, in the New York Hospital, after an illness of three weeks. Mr. Townsend, who lived at the Union Club, was graduated from the academic department of Columbia University in 1893, and received his degree as electrical engineer three years later. He had been connected with the electrical engineering department as assistant tutor and instructor since 1897. For the last few years he had been interested in the development of a new railway signal device, involving many ingenious features, he had invented. This system will be installed on several large railways. He was joint author with Prof. George F. Sever on a work on "Laboratory and Factory Tests in Electrical Engineering." For several years he held the amateur fencing championship of the United States. He was also known as a most talented amateur in musical subjects. He was an associate member of the American Institute of Electrical Engineers.

MR. W. A. WHITTLESEY.—Former State Senator William A. Whittlesey, of Pittsfield, died at his home in that city, last week. He was born in Danbury, Conn., February 21, 1849. He secured his early education in that city and entered Marietta College at Marietta, O., where he was graduated. His first business venture was in the wholesale woolen business, in which he engaged with his brother, John J. Whittlesey, at Detroit, soon after his graduation. Four years later he went to Lebanon, N. Y., and took charge of the literary department of the Henry A. Tilden Company. He remained with the Tilden Company for three years and then returned to Detroit. His health failed and he engaged in the lumber business in northern Wisconsin. Seven years in that region restored him to health, and in 1886, he came East and located in Pittsfield. He took charge of the business of the Pittsfield Illuminating Company, and two years later consolidated it with the Pittsfield Electric Light Company under the name of the Pittsfield Electric Company. In the early nineties he became intersted in some of the electrical devices of Mr. William Stanley, of Great Barrington, and the old Stanley Company was formed. Its growth was rapid. Mr. Whittlesey, who was treasurer and manager, erected large shop and office buildings, which were occupied by the Stanley Company until its removal to Morningside, a few years ago. In 1896, Mr. Whittlesey severed his active connection with the company, retaining his directorship, to give his entire time to the business of the Pittsfield Electric Company, but the industry which had been planted in Pittsfield through his energy has grown to great proportions until to-day it is one of the three large plants of the General Electric Company, and is employing nearly two thousands hands. Mr. Whittlesey was married June 24, 1874, at New Lebanon, N. Y., to Miss Caroline B. Tilden, daughter of Henry Tilden and a niece of Samuel J. Tilden. Mrs. Whittlesey survives him with one daughter. He is also survived by his mother.

Personal.

MR. SYDNEY IRVING WAILES, manager of sales of the National Brake & Electric Company, was married to Miss Adelaide Harrington Brown, at St. John's Church, Los Angeles, Nov. 27.

MR. O. BAERWINKEL, manager of the Excello Arc Lamp Company, will sail on the S. S. *Baltic*, Saturday, Dec. 15, on an important trip in connection with the company's luminous arc lamp business.

MR. R. S. IVES has recently been appointed superintendent of the Chicago & Milwaukee Electric Railroad Company. Mr. Ives held the same position some time ago and is therefore very familiar with the property.

MR. FRANCIS R. WELLES, the representative in France of Western Electric interests, has been visiting this country with his family for three or four weeks past, and leaves for his home in Paris during the current week.

MR. H. L. DOHERTY.—Mr. Henry L. Doherty, general manager of the American Light & Traction Company, is, it is said, to become president of the American Gas & Electric Company, the corporation which is to take over control of the Electric Company of America.

MR. JOHN E. BRADY, of the New York bar, is the author of an article in the current issue of *Profitable Advertising*, entitled "The Law of the Picture," in which are discussed the law and court decisions relating to printing a portrait without consent. Mr. Brady is a regular contributor to the "Legal" columns of this journal.

MR. G. J. A. PAUL.—Superintendent G. J. A. Paul, of the Sharon & Youngstown, Sharon & New Castle and local traction lines has been appointed general superintendent of all lines owned by the Mahoning & Shenango Valley Traction Company in Sharon, Youngstown, New Castle, Niles, Warren and South Sharon, O. He is the first general superintendent the company has had since these lines were merged.

MR. G. W. PICKARD.—We are in receipt of a communication from Mr. Greenleaf W. Pickard, of Amesbury, Mass., in which he protests against the inclusion of his name in the directorate of the new United Wireless Telegraph Company. He says: "This use of my name is entirely without authority and I have refused to serve the new company in any capacity." Moreover, he had already given notification to that effect as far back as November 21, but no attention was paid to his letter by the organizers of the company.

MR. F. H. TAYLOR.—Mr. Frank H. Taylor has been elected vice-president of the Yale & Towne Manufacturing Company. He was born at Cincinnati, Ohio, and after leaving school entered Haverford College where he graduated after a four years' course; immediately after which he entered Harvard University, from which he also graduated, in the class of 1877, receiving the degree of A.B. After leaving college, Mr. Taylor entered the employ of the Geo. Fox Starch Company, of Cincinnati, Ohio, as an apprentice, advancing through various stages to the position of superintendent. In 1882 he moved to Philadelphia, where he became one of the organizers and then treasurer, of the Belmont Iron Company, of which ultimately he became the president. The plant of the company having been destroyed by fire, Mr. Taylor, in 1890, accepted the position of manager of the Philadelphia branch house of the Yale & Towne Mfg. Co., which he retained for the following seven years. In 1897 he transferred his residence to Pittsburg, Pa., to accept the appointment of sales manager of the Westinghouse Electric & Mfg. Co. He served three years in this position, and was then promoted to the position of fourth vice-president, in which he served for about three years, and finally was elected to the position of second vice-president,

which he filled for the following three years, and until he resigned, in April, 1906. He is a director of the Westinghouse Electric & Mfg. Co., and of the Provident Life & Trust Co. of Philadelphia, and one of the trustees of the Engineers' Club of New York.

MR. JOHN M. KLEIN, formerly president and controlling owner of the Jno. M. Klein Electrical Works (incorporated), of San Francisco, has been visiting friends in the East and will remain in New York City for several months, having leased a home on Manhattan Avenue. Mr. Klein is a New Yorker by birth, and entered the employ of the Western Union Telegraph Company in 1869 as a messenger. He remained in its employ in various capacities until 1876 when he resigned to go to San Francisco, where he entered the fire alarm service of that city. He remained in that department until 1879, when he established an electrical supply and construction company, which, under his able management, was built up to be the largest individual concern of its kind on the Pacific coast. His company sold and shipped goods to all parts of the world. Mr. Klein always carried out his contracts, and as electrical expert his advice has often been obtained. He has been all over the world, and is therefore well informed as to the electrical needs of other countries. A few years ago, tiring of active business, he sold out all his interests in the Klein Electrical Company and determined to retire. The recent great calamity of San Francisco has decided him to reenter the electrical field, and he has therefore accepted the position of general manager of the Pioneer Electric Company, Incorporated, a concern having a capital of $1,000,000, of which $100,000 is paid in. Mr. Klein is a member of various trade bodies of his adopted city, has a fine country home in San Rafael and is a Mason of high degree, a Knight Templar, Shriner and Scottish Rite man. He will return to San Francisco in the early spring and will devote his energies to the electrical up-building of the Slope with all the vim that he has shown in the past.

News of the Trade.

GLOBE ENGINEERING COMPANY, of 139 East Third Street, Dayton, Ohio, by vote of the Board of Directors, has decided to discontinue contracting work and to confine its efforts entirely to the jobbing business.

THE BECK FLAMING LAMP COMPANY is now located at its new factory, 30 Greenwich Avenue, New York. New and up-to-date machinery has been installed. Its office and salesroom are also at the same address. At the new location the company has better facilities than it had at the old.

ELECTRIC SERVICE SUPPLIES COMPANY, Plymouth Building, Chicago, has been given additional territory in Michigan, Indiana and Ohio for the full line of Locke material, including insulators, etc., as manufactured by the Locke Insulator Company. Customers for such apparatus in that territory desiring any information as to Locke material can obtain it promptly by writing to the Chicago agents.

THE BARRIETT ELECTRIC MANUFACTURING COMPANY, of Cincinnati, has secured the elevator motor business of one of the best known elevator builders in the Middle West, and is now selling a large number of these equipments. In addition to this it is doing a considerable local business in printing press machinery equipments, in which line the Barriett motors have long held a good record. The past month's business has been heavier than any previous month since the organization of the company.

CHASE-SHAWMUT COMPANY.—It has recently been called to the attention of the Chase-Shawmut Company that the claim is made by some that it is using in its enclosed fuses tubing made of asphaltum paper rather than of fibre, as advertised by it. The Chase-Shawmut Company has recently sent samples of its tubing to an analytical chemist in Boston, who, after exhaustive tests on these samples and of fuses of this company's manufacture, bought in the open market, reports that the tubing used is vulcanized fibre of good quality. The Chase-Shawmut Company will be glad to furnish copies of this report to anyone who is interested.

THE ATLAS ENGINE WORKS, of Indianapolis, recognizing that during th ensuing year the uppermost thought in the buyer's mind will be, "Where can we get quick shipment of goods wanted," begin with this issue to publish in our columns a list of their engines and boilers in stock, which will be kept current with each issue. This is an entirely new departure in the engine and boiler business. The Atlas Engine people have just closed an extraordinary year, claiming to have increased their sales 85 per cent. and shipments 90 per cent, and it is their proud boast that they have so taken care of the remarkable increase in business as not to have had at the end of their fiscal year one single past due order on their books.

THE FAIRBANKS-MORSE ELECTRIC MANUFACTURING COMPANY, Indianapolis, Ind., has built a factory designed especially for the manufacture of dynamos and motors. The company is affiliated with Fairbanks, Morse & Co., Chicago. This firm took up a new line of induction motors last July, but was unable to manufacture at its electric plant at Three Rivers, Mich., on account of the large volume of direct-current work on hand. The Indianapolis factory will produce standard EE type dynamos and motors for direct-current lighting and power; standard E type motors, open or semi-inclosed; standard E type direct-current dynamos; special motors, such as single belt reversing elevator motors, back-geared motors, inclosed and semi-inclosed type motors, buffing lathe motors and motor generators, induction motor starting devices, alternating-current B type constant-speed induction motors, engine-type generators, gas and gasoline engines for electric light and power plants.

CORLISS ENGINE WORKS.—Mr. E. K. Hill, chairman of the engineering committee of the American and British Manufacturing Company, of Providence, R. I., writes us: "A fire occurred in the early morning hours of Nov. 5 at the Corliss Steam Engine Works, of this company. It occasioned wild and exaggerated rumors and comment, which were entirely unfounded. The fire was confined to the Diesel engine testing building, which was entirely destroyed. The rumors arose from the supposition that the oil used in the engines was the occasion of the fire and also because there was an explosion of some violence. The facts are that the building appears to have ignited from the outside and the small amount of oil used in the Diesel engine testing had no appreciable effect in adding to the fire. The explosion was due to compressed air in flasks which, under the increased pressure of the heated air and the softening of the metal of the flasks, naturally exploded. The effects of the explosion were local and very limited, as is the well known effect of compressed air explosions. There will be no material interference with the output of the works in any department."

AMERICAN TRACING CLOTH COMPANY.—It will be of great interest to a large number of readers to learn that tracing cloth is now being manufactured in the United States. This is the first time that an American manufacturer has succeeded in turning out tracing cloth equal in every respect to the imported cloth. The domestic cloth is made by the American Tracing Cloth Company, No. 11 Broadway, New York City, while the factory is at Paterson, N. J. The cloth is sold under the name of "Peerless." This company has succeeded in creating the conditions necessary for the manufacture of tracing cloth, by means which they guard carefully. It was also necessary for them to specially design the machinery and they hold several patents on these designs. The credit of discovering the process is due to a graduate of a German university, who is a very prominent man in his profession, while the machinery was designed by an experienced man who has had a long and successful career in textile work. The financial interest backing this company is strong and is composed of men well known in the financial world. The manufacturers are quite confident that their product will in time replace the imported article, once the consumer has found out that he can purchase a perfect tracing cloth which is made in this country at a cheaper price. The manufacturers invite criticism, and will gladly mail samples of their product to any one who wishes to try it.

Weekly Record of Electrical Patents.

UNITED STATES PATENTS ISSUED DEC. 4, 1906.

[Conducted by Rosenbaum & Stockbridge. Pat. Atty's., 140 Nassau St., N. Y.]

837,277. ELECTRIC FURNACE. Kristian Birkeland and Samuel Edye, Christiania, Norway. App. filed Nov. 10, 1904. In an electric furnace, an electrode formed of a tubular piece of electrically-conducting material and having its ends serrated to form one or more points.

837,296. ELECTRIC WELDING APPARATUS. Weston M. Fulton and John S. Brown, Knoxville, Tenn. App. filed June 23, 1904. In order to avoid the unequal heating effect due to scale when welding together thin sheet metals, the patentee has grinding rollers which act continuously to brighten the contact surface of the electrode during action.

837,304. ATTACHMENT FOR MOUTHPIECES OF TELEPHONE-TRANSMITTERS. Joseph G. Kitchell, New York, N. Y. App. filed Nov. 31, 1905. In a device of the class described, an inner and an outer wall with an air-space between, sound-deadening material secured to the outer surface of the outer wall, and a mouthpiece connected to the walls.

837,336. SIGNAL. Thomas R. Nicholas, Carthage, Mo. App. filed May 10, 1906. A construction of semaphore signal having a weighted arm which is normally held in elevated position by a magnet and which falls to impinge against a detent so as to release the semaphore arm.

837,369. ELECTROPNEUMATIC BRAKE. Edward A. Wright Edgewood Park, and Walter V. Turner, Wilkinsburg, Pa. App. filed Mar. 20, 1905. The train pipe works in the usual way on a triple valve, but is provided with additional outlets controlled by magnet operated valves so that the air brake system is electrically and pneumatically controlled.

837,396. ELECTRIC CONTROLLING SYSTEM. Urias J. Fry, Milwaukee, Wis. App. filed Apr. 9, 1906. Relates to an electric switch and signal controlling mechanism in which the switches and signals are made electrically interlocking by the use of special relays and connections.

837,411. REGULATING DEVICE FOR ELECTRIC METERS. Robert C. Lanphier, Springfield, Ill. App. filed Dec. 13, 1905. Has a shunt energizing coil and a condenser in series with said coil and an adjustable air gap in the main magnetic circuit.

837,413. TELEGRAPH-TRANSMITTER. Charles W. Leiser, Salt Lake City, Utah. App. filed Aug. 30, 1905. An electric vibrating device is controlled by two circuits so as to vibrate for the transmission of dots when one circuit is completed, and for the transmission of dashes when another circuit is completed. The purpose is to relieve the operator of the necessity of repeated movements in transmitting messages.

837,425. COMMUTATOR. Stanley S. Seyfert, South Bethlehem, Pa. App. filed Feb. 20, 1905. Relates to alternating current motors and is particularly adapted to prevent the transformer action in the idle coil of the armature during commutation. Has choke coil windings which introduce an inductive resistance.

837,440. RECEIVING DEVICE FOR BOND DETECTORS. Harris A. Watson, Sylvania, O. App. filed Apr. 13, 1905. A Y-shaped tool is adapted to be placed against the rail at a joint and to complete a circuit with a telephone receiver so as to test the resistance.

837,457. TELEPHONE-TRANSMITTER. Fred W. Fahrenfeld, Rochester, N. Y. App. filed Aug. 31, 1905. In a transmitter, the combination with a casing having a side wall, a ring of insulating material located

within said wall having a shoulder and a bridge-piece supported on said shoulder, of a vibratory diaphragm secured at its edges to the edges of the said walls, electrode-plates secured to the bridge-piece and diaphragm and granular conductive material located between the plates.

837,469. TELEPHONE-RECEIVER. Stephen C. Houghton, Syracuse, N. Y. App. filed Feb. 18, 1905. In a telephone, the combination with a fixed support, of a permanent magnet of the horseshoe type for the receiver, the heel of which embraces said support and a receiver connected to the extremities of the arms of said magnet, substantially as described.

837,470. HAND-TELEPHONE. Stephen C. Houghton and Frank M. Potter, Jr., Syracuse, N. Y. App. filed Oct. 5, 1905. Relates to a telephone having an ear piece and a mouth piece in the same integral structure. Has a magnet long enough to provide a hand engaging portion between its poles and heel.

837,498. INDICATING ELECTRIC SWITCH COVER. Charles G. Perkins, Hartford, Conn. App. filed Jan. 26, 1906. The switch box is made with apertures in the cover and a disc is marked in a special way so as to indicate the position of the switch.

837,503. TELEPHONE. Samuel J. Port, Birmingham, England. App. filed Aug. 14, 1905. Relates to details of a supporting frame for holding a pair of receivers of a telephone set.

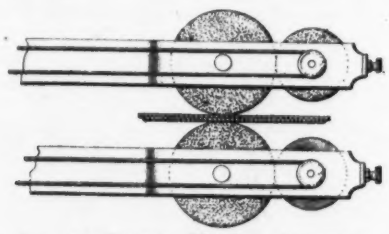
837,512. ELECTRIC HOSE SIGNALING APPARATUS. William G. Seeley, Brookline, Mass. App. filed Nov. 27, 1905. A pair of flexible strips are included in the hose and sinuous wires are placed between these strips so as to establish telephonic connection.

837,522. AUTOMATIC APPARATUS FOR CONTROLLING AND OPERATING THE POINTS OF ELECTRIC RAILWAYS AND TRAMWAYS. William H. Turner, Rowland E. Dixon and Thomas B. Stewart, Leeds, England. An electrical track switch in which the motorman may take power through his controller to postion the switch point in a certain way, and the point is thereupon automatically locked and not released until the car has passed.

837,534. TELEPHONE-APPARATUS. Garrison Barcock, Rochester, N. Y. App. filed Aug. 31, 1905. In a telephone set, the combination with a circuit and a receiver and transmitter arranged therein, a supporting-handle on one of the parts comprising holding-arms adapted detachably retain the other part in proximity thereto.

837,567. SECONDARY-BATTERY PLATE. Frank C. Hood, Philadelphia, Pa. App. filed Feb. 20, 1906. A battery-plate comprising a continuous series of parallel loops of finely-corrugated lead tape, separate strips of more deeply-corrugated lead tape interposed between the arms of each of said loops, cross-bars at the top and bottom of the plate, and longitudinal bars connecting said cross-bars between the ends and secured to the loops and strips.

837,594. TELEPHONE-MOUTHPIECE SAFETY-GUARD. Edward Stempel, San Francisco, Cal. App. filed Oct. 20, 1905. A guard or frame adapted to be clamped to the transmitter and project slightly forward with respect thereto.



837,296.—Electric Welding Apparatus.

837,599. TEST-CLAMP. John H. Williams, East Cleveland, O. App. filed Mar. 8, 1906. A pair of spring nippers are provided with a group of needles on one of the jaws which pierce the insulation of the wire to establish an electric connection.

837,616. WIRELESS TELEGRAPH SYSTEM. Henry H. C. Dunwoody, Washington, D. C. App. filed Mar. 23, 1906. A detector making use of crystalline silicid of carbon or carborundum. Two blocks of the material are placed in light contact and included in the antenna circuit.

837,634. ELECTRIC SWITCH. George P. McDonnell, St. Louis, Mo. App. filed Nov. 9, 1905. A plurality of discs are arranged upon a shaft and each has an annular segment removably attached thereto which contacts with fixed blades to establish different electrical circuits.

837,635. BELL-RINGING CIRCUIT. George P. McDonnell, St. Louis, Mo. App. filed Nov. 20, 1905. Relates to details of a ringing circuit having a resistance bar specially included therein.

837,636. BELL-RINGING CIRCUIT. George P. McDonnell, St. Louis, Mo. App. filed Dec. 28, 1905. Modifications of the above, including a resistance by-pass and means by which the resistance thereof is cut out when the bell ringing circuit is closed.

837,638. LAMP SOCKET. William H. Nichols, Bennington, Vt. App. filed Sept. 23, 1905. The central stud terminal of the lamp is utilized as a switch contact and a blade is impelled into contact therewith by a hard rubber block or cam.

837,654. FINISHING OR GUARD RING FOR ELECTRIC CONDUITS. Albert I. Appleton, Chicago, Ill. A threaded bushing at the end of a conduit pipe has a ring which is positioned thereon in a special way so as to form a smooth surface for the engagement of the conduit wires.

837,670. ELECTRIC SIGNAL. Harold W. Eden, Detroit, Mich. App. filed Feb. 5, 1906. Details of construction of an ordinary bell having cast iron base and a lug projecting therefrom in which the bell armature is pivoted between adjustable cone bearings.

837,671. FRAME FOR ELECTRIC BELLS. Harold W. Eden, Detroit, Mich. App. filed Feb. 5, 1906. Another detail feature of a bell relating to the terminals for the electric circuit wires which are fastened upon the yoke of the bell magnet.

837,672. ELECTRIC BELL. Harold W. Eden, Detroit, Mich. App. filed Dec. 26, 1905. Additional details of an electric bell, including a special form of strap by which the armature is attached to the contact spring.

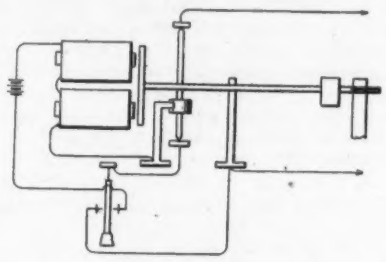
837,673. ELECTRIC SIGNAL BELL. Harold W. Eden, Detroit, Mich. App. filed Dec. 26, 1905. Still further details of an electric bell, and particularly the circuits, including a resistance in one branch of a divided circuit, the other branch being adapted to be short-circuited through the sounding member.

837,674. ELECTRIC SIGNAL. Harold W. Eden, Detroit, Mich. App. filed Dec. 26, 1905. Still further details of an electric bell, and particularly a form of connector between the windings of the magnet coils which also serves as a contact for the vibrator.

837,675. ELECTRICALLY ACTUATED SIGNAL BELL. Harold W. Eden, Detroit, Mich. App. filed July 18, 1906. Still further details of an electric bell relating particularly to a sheet metal base having a specially formed stamped hole with ears which receives a post to support the vibrator contact.

837,693. GROUND CONNECTION FOR TELEPHONE-WIRES. Charles Lanz, Knoxville, Pa. App. filed Oct. 10, 1905. A ground connection comprising a rod, a wire coiled around said rod, a disc on the rod at the coil, and spelter covering said rod and connecting said disc and coil to the rod.

837,701. ELECTRIC MOTOR. David Mendelson, Brooklyn, N. Y. App. filed Mar. 24, 1906. A form of an electric motor adapted to move a vibrator and adapted for the purposes of window advertising. Is adjustable into any angular position.



837,413.—Telegraph Transmitter.

837,749. INSULATOR. Louis Steinberger, New York, N. Y. App. filed Dec. 11, 1905. A conical insulating base, has annular grooves or terraces which contain oil so as to provide more effective insulation.

837,770. ANNUNCIATOR ATTACHMENT FOR MAIL BOXES. Wayne B. Allen, Columbia, Mo. App. filed Oct. 24, 1905. The bottom of the mail box has a plurality of spring blades which are depressed by the weight of the letters to close a signal circuit.

837,771. SELF-RESTORING TROLLEY. James T. Andrew, Montgomery, Ala. App. filed Sept. 7, 1905. The trolley wheel is made with spiral grooves on either side thereof, terminating in eccentric beveled discs adjacent to the wheel and which serve to restore the trolley wire thereto.

837,773. CLEANING STORAGE BATTERIES. Jonas W. Aylsworth, East Orange, N. J. App. filed Sept. 8, 1904. The process of cleaning the metallic surfaces of an alkaline storage battery, which consists in subjecting the surfaces to the action of a hot, weak alkaline solution, substantially as and for the purposes set forth.

837,836. TROLLEY HEAD FOR ELECTRICAL TRAMWAY SYSTEMS. Garnet B. Holmes and Arthur D. Allen, Wellington, New Zealand. App. filed Mar. 26, 1906. The harp is pivoted to the pole so as to move into a vertical position or be displaced into a horizontal position. A latch is adapted to lock the harp in either position and is controllable by the usual trolley cord.

837,853. ALTERNATING CURRENT MAGNETIC APPARATUS. David Larson, Yonkers, N. Y. App. filed Nov. 15, 1905. A form of alternating current magnet for elevator brakes. Is connected by special toggle joints with the brakes so as to receive a gradually increasing load when the brakes are applied.

837,854. ALTERNATING CURRENT MAGNETIC APPARATUS. David Larson, Yonkers, N. Y. App. filed Nov. 22, 1905. Relates to modifications of the above.

837,857. RAILROAD SIGNAL. Ernest C. Lombard, Peoria, Ill. App. filed Sept. 22, 1906. A magazine contains torpedoes and a magnet is effective to feed the torpedoes successively on to the track rails under the control of an electric circuit.

837,888. ELEVATOR ATTACHMENT. Charles Schaelling, Eureka, Utah. App. filed Nov. 25, 1905. Relates to elevators for mines in which car receiving chairs are provided in the shaft. Has a signal device to indicate the position of the chairs in advance of the car.

837,889. MEANS FOR COMMUTATING MOTOR AND OTHER ELECTRIC CURRENTS. Stanley S. Seyfert, South Bethlehem, Pa. App. filed Feb. 6, 1904. In an electrical device, the combination of an armature comprising coils, a feed-wire, a device for commutating current from said feed-wire to armature-coils, said device comprising leads, and a plurality of inductance-coils connected in each of said leads, oppositely-wound coils in adjacent leads having a common magnetic circuit.

837,894. TELEPHONE SYSTEM. Johan A. Aven, Stockholm, Sweden. App. filed Aug. 22, 1905. Relates to details of a telephone system having an annunciator board and a special arrangement of the signal circuits.

837,897. CONNECTOR FOR STORAGE BATTERIES. Absilam F. Clark, Philadelphia, Pa. App. filed May 12, 1903. A form of terminal connection for the lead plates of storage batteries. The lugs on the plates have a pin cast therein and a terminal conductor into which said pin extends, the whole being encased in cast lead.

837,599.—Test Clamp.

837,898. THERMOSTAT. Harvey Cortland, Pittsburg, and Stephen J. Heinrich, Allegheny, Pa. App. filed Nov. 21, 1905. A box contains a spring impelled switch arm which is normally restrained against movement by connection with a fusible button or pellet. This button or pellet is exposed to the air of the room so as to soften and close the switch in case of fire.

837,901. WIRELESS TELEGRAPHY. Lee De Forest, New York, N. Y. App. filed Feb. 14, 1906. An oscillation-detector comprising two electrodes separated by a heated gaseous medium, one of said electrodes consisting of mercury.

837,903. INSULATED RAIL JOINT. Marquis D. Hanlon, Wilkinsburg, Pa. App. filed Apr. 4, 1906. Designed to avoid the insulation being rapidly worn away between the rail and the splice bar. Employs fillers having projections between the rail and the insulation.

12,571. PORTABLE ELECTRICALLY OPERATED DRILL. Adolph Pedersen, Cleveland, O. App. filed June 25, 1906. In an electric motor provided with a relatively stationary casing, a drill handle and means for controlling the operation of the drill through said handle.